MACHINERY
August, 1910

THE ELLIS ADDING TYPEWRITER

THE PRINCIPLE OF THE ADDING MECHANISM, AND ITS APPLICATION TO A NEW TYPE OF MACHINE

By RALPH E. FLANDERS

THE commercial adding machine is so fearfully and wonderfully made, that it might well seem a reckless undertaking to describe it in a general way for the general mechanical reader. The temptation is strong, however, in the case of the machine here illustrated, for

Fig. 1. The Ellis Adding Typewriter

three reasons. The first of these is the courtesy of the makers, the Ellis Adding Typewriter Co. of Newark, N. J., who went beyond the usual bounds in giving explanations and offering facilities for investigation. The second is the fact that the machine, while very highly developed, is yet so arranged that the principles involved can be easily and clearly illustrated. The third reason is the fact that the whole mechanism is full of suggestion to the designer of automatic machines in other lines, on the score of the particular movements employed, as well as on the score of the general orderliness of the design.

STATEMENT
of
Debits and Credits.

Month of October 1909.

Ledger Page	Account	Debit	Credit
		$ 0[B]	0[C]
14	Riker & Hindell	350.00	
16	B. W. Sayre		$ 45.60
112	F. W. Taylor		456.35
126	J. H. Thompson	125.00	
147	C. D. Wendell	34.56	
153	Owen Ward		42.50
177	M. V. Cooke	51.50	
204	C. E. DeJonge	61.59	
219	M. N. Droehler		501.35
256	Drake & Son	112.61	
347	Jno. A. Eaton	47.15	
360	D. C. Fisher	69.45	
362	L. H. Watters		47.32
367	S. A. Williams		38.00
481	Hall & Conklin Co.	1,116.32	
474	The Western Grain Co.		1,425.21
475	Elmer A. Smith		147.85
476	Lawrence & Lawrence	218.76	
	Total	$2,183.14[B]	$2,791.68[C]

Fig. 2. Sample of Double-column Work done by the Machine

With this preamble, and with the assurance that the mechanism will be described in its larger features only, it is hoped that the reader will have the courage to follow the explanation through.

The Work of the Adding Typewriter

First let it be briefly stated what this machine is and what it will do; we can then pass on to a discussion of the way in which it performs its work. It is a combination of two completely developed machines—a visible typewriter and an adding machine, both writing on the same line on the same piece of paper, in plain sight of the operator, and each designed to possess all the advantages with which the best separate machines of its class are provided.

An example of the work of which the machine is capable is shown in Fig. 2, which illustrates a statement, including both debit and credit accounts written down indiscriminately, with each set of items added up and printed in a total at the bottom. The writing is done with the typewriter in regular typewriter fashion, and the figures are set up and printed in regular adding-machine fashion, on the same line and at the same time that the reading matter is written. This evidently requires two adding mechanisms, or two "accumulators" as they are called, one for the debit and the other for the credit column. This provision of two accumulators with the accompanying adjustments for their convenient use in relation to each other, is a novel feature in adding-machine construction.

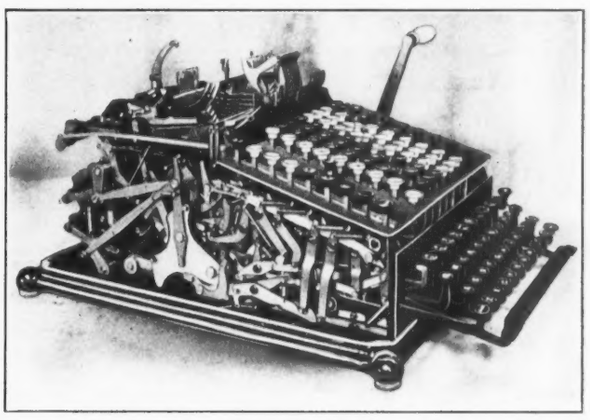


Fig. 3. Front and Left-hand View of the Machine with the Case Removed

Besides this, the machine is adapted to perform numerous other "stunts" such as the printing of items in a series of vertical columns, and the adding of these columns into totals both horizontally and vertically. Finally these totals, both horizontal and vertical, may be added together in a grand total. This operation is useful for such work as cost sheets, etc. Discounts may also be reckoned, amounts may be subtracted from each other, and so on, enabling the machine to do a wide range of commercial work.

Perhaps this recital of the intricate processes of which the machine is capable sounds rather confusing, but it will be made plain by the following description of the action of the adding mechanism.

The Principle of Action of the Adding Machine

Figs. 5, 6, 7 and 8 illustrate the principle on which the machine works. Figs. 1 and 10 show that the adding keyboard is composed of nine vertical rows of nine keys each. The lower key of each row is numbered 1, the next 2, and so on up to 9. Of the nine vertical rows the first one on the right is for

units and the next for tens, etc.; or, since the punctuation is usually set for reckoning in dollars and cents, the first is for cents, the next for dimes, and the succeeding rows for dollars.

Figs. 5 and 6 show digrammatic sections through the machine along the line of any one of these vertical rows of adding keys, say the first or cents column for instance. The keys are shown at *G*. Other important parts of the mechanism are the rack *A*, the type sector *F* by means of which the

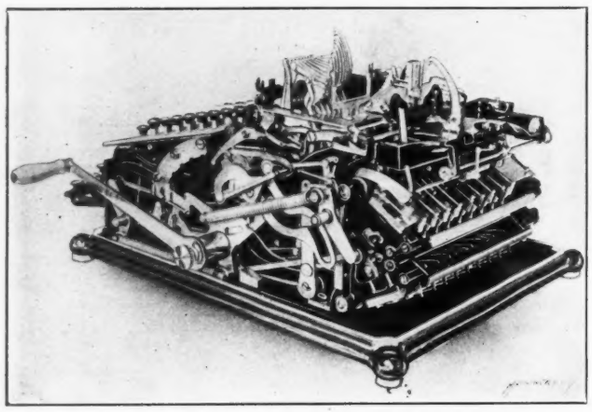


Fig. 4. Rear and Right-hand View with Case Removed, showing Operating Mechanism and Accumulators

numbers are printed on paper carried by roller *K* and the accumulator wheels *B*, by which the addition is performed. All these, as well as the other moving mechanism shown in Figs. 5 and 6 are duplicated for each one of the nine rows of keys, there being nine racks, nine type bars, nine sets of accumulator wheels, etc., in all.

The adding mechanism is operated by the movement of rack *A*. This movement takes place under the influence of spring *O* whenever stop *N* is swung back as shown in Fig. 6 by the operation of the handle of the machine. The length of the movement which spring *O* thus gives to rack *A* is determined by keys *G*. If the figure $476.34 is set up on the keyboard, for instance, key "4" will be depressed in the cents column, and when the movement of the rack takes place, the rack teeth beneath the accumulator wheel will have moved four spaces.

This is more clearly seen in Fig. 5 where each of the keys *G* is shown to be mounted on a stem which carries a stop *H* at the lower end. When the keys are depressed, these stops come into line with corresponding steps formed at the left-hand end of the rack *A*. These steps are so proportioned that when key 1 is depressed, for instance, the rack is allowed to move one tooth before striking its abutment. When key 2 is depressed it moves two teeth and so on as shown by the dimensions at the bottom of Fig. 5. When no key is depressed, indicating zero, then a stop is interposed which prevents any movement of the rack. When key 9 is depressed, the rack takes the full movement of nine teeth allowed by the striking of the lips on the under side of the rack against supporting bar *J*.

Each rack *A* has cut in it a slot engaging pin *C* in sector *D*. Each sector is in turn connected by link *E* with the type bar *F*, carrying characters from 0 to 9. Whenever, as shown in Fig. 6, a key (key 4, for instance,) is depressed and the rack is allowed to move four teeth backward under the influence of spring *O*, the type bar *F* is thereby set at the corresponding figure. The throwing forward of lever *L* to which the type bar is pivoted then prints this figure "4" on paper wrapped about roll *K* as shown in Fig. 6. It is important to remember that rack *A* and type bar *F* are positively connected under all conditions. It should, perhaps, be mentioned that the teeth in sector *D* simply provide for more accurate alignment of the type in printing than would otherwise be possible. Just before the printing stroke takes place arm *W* swings up, carrying a plate which enters the corresponding tooth space in each one of the nine sectors *D*, aligning all the figures on type bars *F* and giving a good, evenly printed number on paper.

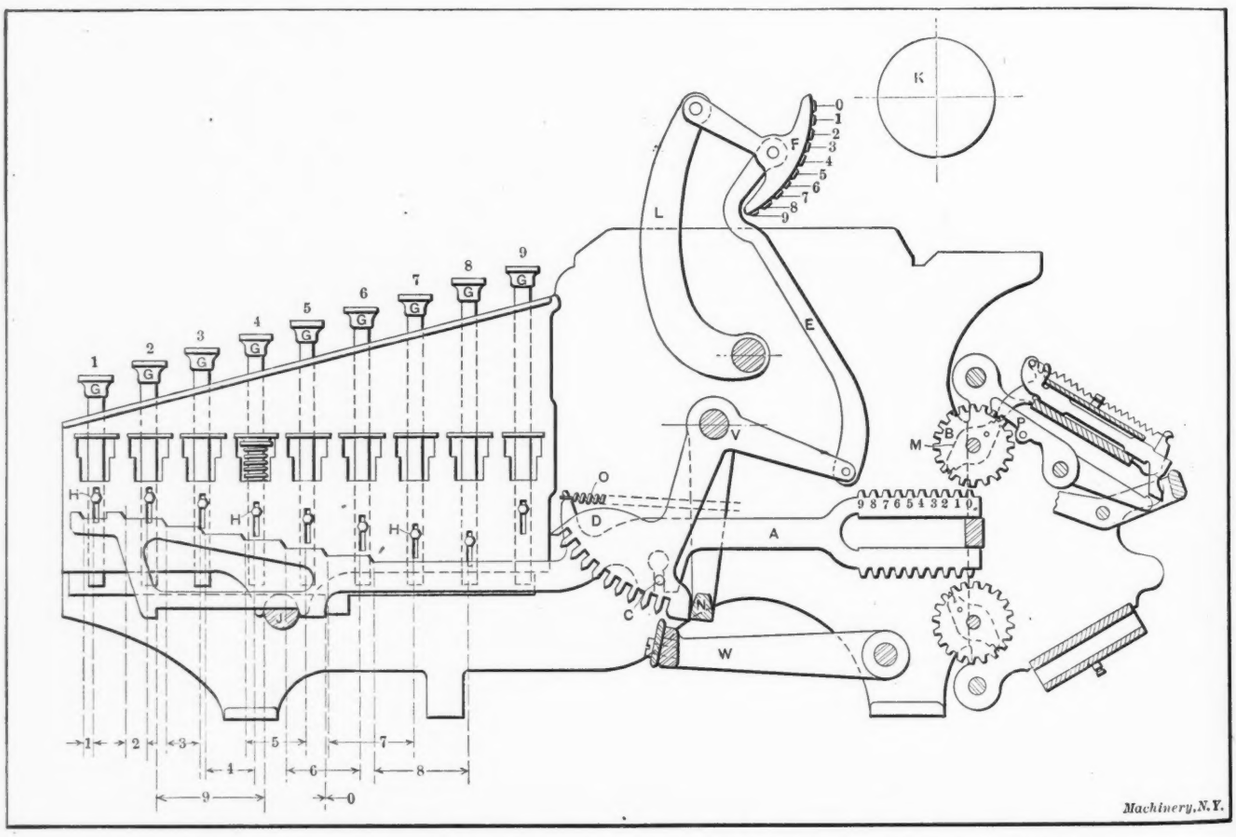


Fig. 5. Diagrammatic Cross-section of the Machine showing Relation of Keys, Racks, Accumulators and Printing Mechanism

Now we come to the accumulator mechanism in which the adding is done. There are ordinarily, as explained, nine accumulator wheels for each of the nine racks. Here, however, there are two sets of these nine wheels, one above rack *A* and the other below. The upper one is the debit accumulator for addition in the debit column and the other is the credit accumulator for the credit column. A general view of the

mechanism is shown later in Fig. 9. We will, for the time being, consider only the upper or debit accumulator.

This set of nine accumulator wheels, of which only one is shown at *B* in Figs. 5 and 6, may be swung into and out of engagement with the teeth of racks *A* at will. These accumulator wheels have 20 teeth each. They might as well have ten, except for the fact that it would make them inconveniently small. Each wheel is provided with a two-tooth ratchet *M* positively pinned to it. This ratchet therefore spans ten of the wheel teeth between its points. Pawl *P* is adapted to engage the teeth of ratchet *M*, and is connected with mechanism by means of which the tens are carried from one column to another (that is, from one accumulator wheel to another) as will be later described. With this rapid review of the mechanism, we can turn to Fig. 7, which shows in diagrammatic form the method of procedure followed in the simple problem of adding 4 to 9, and getting the sum 13.

The Order of Operations for Adding

At *A* in Fig. 7 the machine is shown "clear," that is with the accumulator wheels at zero, which means that one tooth shown at *H*. In doing this, one of the teeth of the two-tooth ratchet as it passes under the pawl raises it, as shown by the full and dotted lines at *H*. This raising of the pawl operates a spring-loaded mechanism, which shifts the next accumulator wheel (that for the tens column) one tooth, when the wheels are returned from engagement in operation *I*. This operation exactly corresponds to that of "carrying" when adding with pencil and paper. This is here done automatically. It is not thought advisable to describe this carrying mechanism in detail as the parts are small and rather complicated, though the action is simple enough.

(The mechanism may be understood a little more clearly, however, if the reader follows the actions of the wheels when every one of them in the accumulator, from cents up to the millions of dollars is set at 9—that is to say, when they are set up for 9,999,999.99. Now suppose that one cent is added in, so that the first wheel is moved beyond 9—that is, to 0. The tooth of the ratchet *M* will then pass under the first pawl, raising it. Now when the accumulator wheels return from engagement, this raising of the first pawl releases a spring-loaded mechanism which moves the next wheel from 9 to 0.

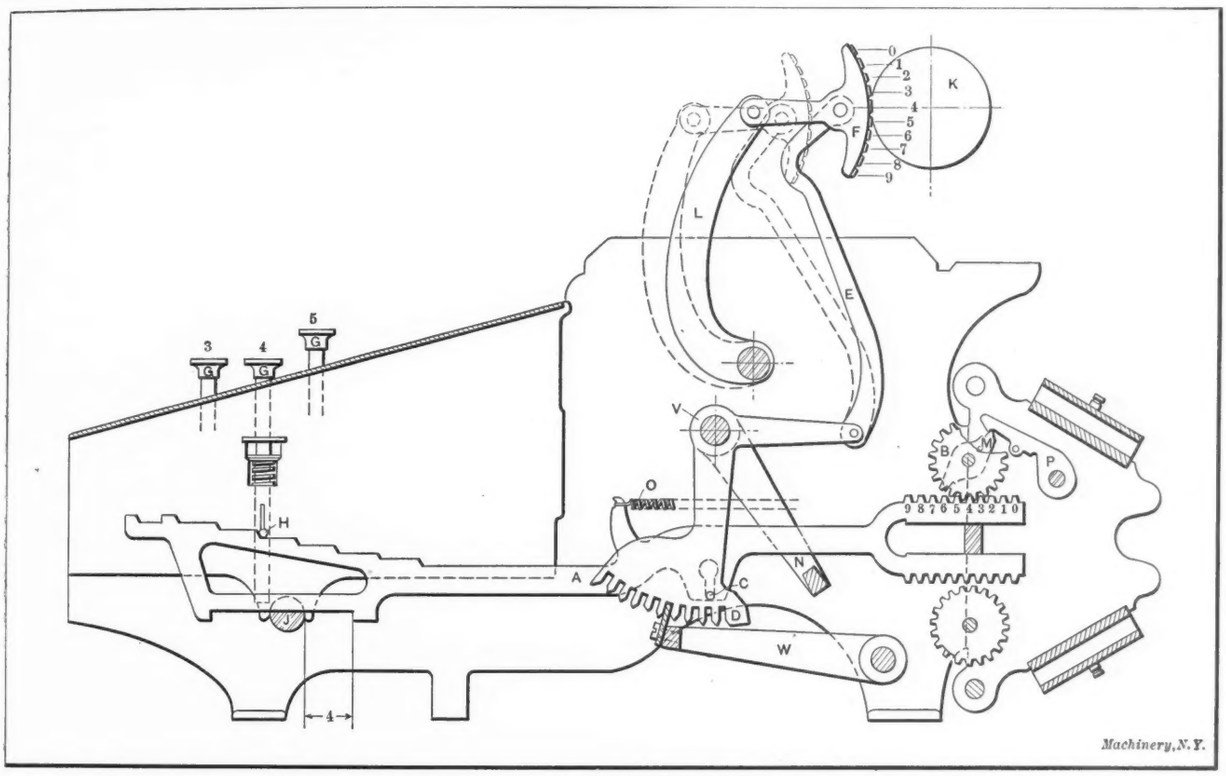


Fig. 6. Diagrammatic Cross-section showing the Machine set up for Printing the Number 4 and Adding it into the Accumulator

of the two-tooth ratchet is up against the hook of the pawl. Key 4, corresponding to the number we wish to add into the accumulator wheel, is now depressed and the operating handle of the machine is pulled over. The first thing that takes place is that the rack is allowed to move four teeth to the right as shown at *B* (see also Fig. 6). In this position the number "4" is printed. Next (as shown at *C* in Fig. 7) the mechanism automatically throws the accumulator wheel down into engagement with the rack. Then as the operator allows the handle to return, the next thing that takes place is the return of the rack to the zero position again as shown at *D*, carrying the accumulator wheel with it a space of 4 teeth from its zero position. The mechanism then disengages the accumulator wheel, leaving the machine ready for the next operation with the 4 added into the accumulator, as shown at *E*.

We now wish to add 9 to the 4. Key 9 is depressed and the operator pulls the handle. This results in a movement of nine teeth of the rack as shown at *F* in Fig. 7. The figure "9" is then printed. The accumulator wheel is next engaged, as at *G*. Then the rack is returned to the zero position as at *H*, and the accumulator wheel is disengaged as at *I*. This evidently moves the accumulator wheel $9 + 4 = 13$ teeth as This, in turn, moves the next wheel from 9 to 0 and so on until each one of the row has been advanced one tooth, setting the whole row at 0,000,000.00. This operation, of course, takes place in a flash. It is done so rapidly that neither the eye nor the ear can take in the successive operations, but each one is dependent on the preceding one. So much for the carrying mechanism.)

We have now added 9 and 4 into the accumulator wheel. Of course, this process can be carried on indefinitely, adding in any number of different numbers. Suppose that we now are through with the addition and wish to take a total. How is this done? The operations required are shown at *J*, *K*, *L*, and *M* in Fig. 7.

Finding the Total

The first thing the operator does is to depress the "credit total" key at the left of the key-board, the sum having been added into the upper or credit accumulator. He then pulls the operating handle, and the next thing that takes place, as shown at *J*, is the throwing of the accumulator wheels into engagement with the racks. The next operation is the release of the racks so that the springs move them toward the right. There are in this case no keys depressed in the key-board, so that the racks would move the full distance of nine

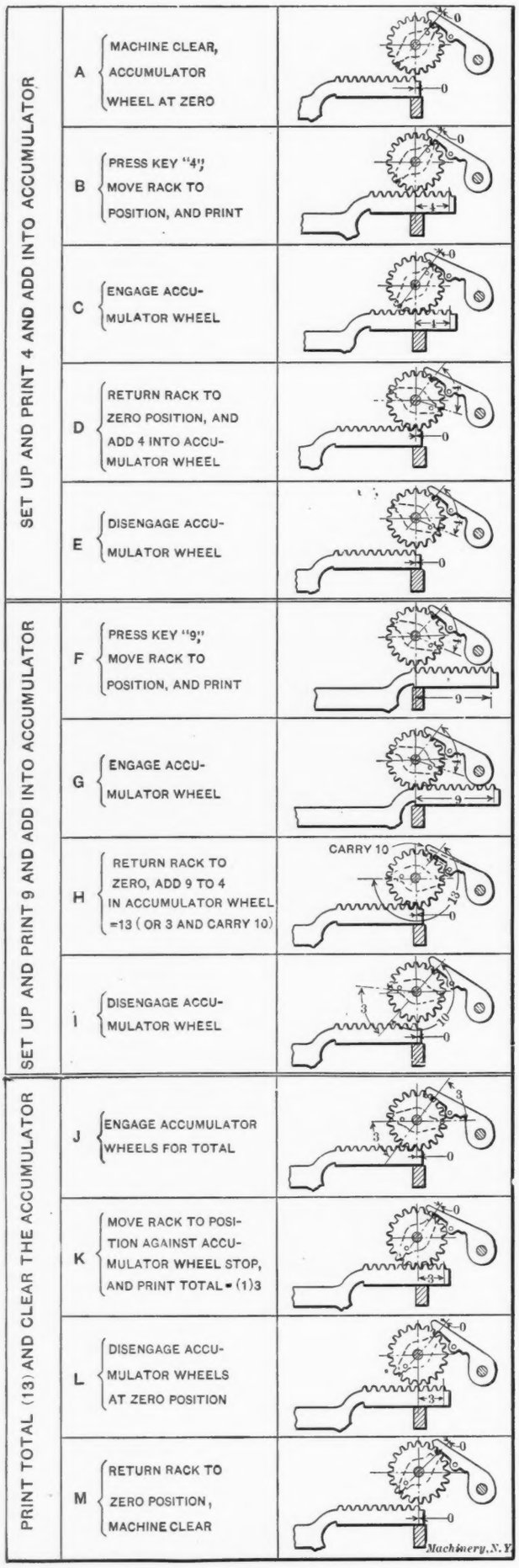

SET UP AND PRINT 4 AND ADD INTO ACCUMULATOR
A MACHINE CLEAR, ACCUMULATOR WHEEL AT ZERO
B PRESS KEY "4"; MOVE RACK TO POSITION, AND PRINT
C ENGAGE ACCUMULATOR WHEEL
D RETURN RACK TO ZERO POSITION, AND ADD 4 INTO ACCUMULATOR WHEEL
E DISENGAGE ACCUMULATOR WHEEL
SET UP AND PRINT 9 AND ADD INTO ACCUMULATOR
F PRESS KEY "9"; MOVE RACK TO POSITION, AND PRINT
G ENGAGE ACCUMULATOR WHEEL
H RETURN RACK TO ZERO, ADD 9 TO 4 IN ACCUMULATOR WHEEL =13 (OR 3 AND CARRY 10)
CARRY 10
I DISENGAGE ACCUMULATOR WHEEL
PRINT TOTAL (13) AND CLEAR THE ACCUMULATOR
J ENGAGE ACCUMULATOR WHEELS FOR TOTAL
K MOVE RACK TO POSITION AGAINST ACCUMULATOR WHEEL STOP, AND PRINT TOTAL = (1)3
L DISENGAGE ACCUMULATOR WHEELS AT ZERO POSITION
M RETURN RACK TO ZERO POSITION, MACHINE CLEAR
Machinery, N.Y.

Fig. 7. Diagram Illustrating the Principle of Action of the Ellis Adding Typewriter

teeth, were it not for the fact that they have to carry the accumulator wheels with them, and the ratchets on these wheels come in contact with the pawls, thus arresting their movement and stopping the movement of the racks.

Now in the operation *I*, adding 9 into the 4 already in the wheel had set the units wheel 3 teeth beyond the point of the ratchet, and the tens wheel 1 tooth beyond the point of the ratchet. It is evident, then, that in operation *K* the units rack will be allowed to move 3 teeth and the tens rack 1 tooth. This, as shown in Fig. 6, will evidently set up the unit type bar at "3" and the tens type bar at "1." On the return of the handle the printing mechanism is operated, transferring the total "13" to the paper. The accumulator wheel will then be released, and the rack will be allowed to return to the zero position as shown at *M*. This leaves all the accumulator wheels back in the zero position, with the teeth of the ratchets back against the pawls, leaving the machine "clear" as at *A*, ready for the next operation.

Taking Sub-totals, etc.

It might have been desired to print a sub-total instead of a total. That is to say, it might have been desired to print a total for the addition as far as it had proceeded, but not to clear the machine, thus permitting more figures to be set up and printed and added into the same sum. Sub-totals can be printed at any point in the adding up of a line of figures, as required, by a simple change in the operation shown at *J*, *K*, *L* and *M* in Fig. 7. This consists simply in allowing the wheels to remain in engagement at *L*, so that the racks, when they return in operation *M*, will bring the wheels to the same position as they had in *J*, thus leaving the totals still set up in the accumulator.

Since there are two independent accumulators, it is evident that a number can be added into either one or both of them; or a total or sub-total can be taken from one of them and added into the other—all depending on the manipulation of the keys and the time of throwing the accumulator wheels into and out of action.

The order of the operations followed in printing without adding, in printing and adding, taking sub-totals, and taking totals to clear the machine, are all given in tabular form in Fig. 8. A study of Figs. 5, 6, 7 and 8, should serve to give a clear idea of the principle underlying the operation of the mechanism. It should be stated that this principle is not original with this particular machine, but was invented many years ago and has been adopted by all commercial adding machines of this type. It is worked out differently here, however, than in other machines, and in a way that offers a number of advantages.

The Various Sections of the Machine in Detail—The Accumulator

One of the fundamental features in the design of this machine is the fact that it is arranged to be built in sections. There are fourteen of these sections, each of which takes care of some particular function of the whole machine. The first of these to be described is the double accumulator, two views of which are shown in Fig. 9. This forms a self-contained unit. The accumulator wheels and the two-tooth ratchets shown in the previous diagrams will be readily seen in the engraving. The springs seen on the accumulator at the left, actuate the device for carrying the tens from one wheel to the next, to which reference has already been made. The upper accumulator is for the debit totals and the lower for the credit totals. Either set of wheels may be thrown in by the operation of the levers (marked *Q*), shown at the end of the accumulator at the right of the engraving. These levers, one of which is shown in Fig. 17, are operated by a mechanism at the left-hand side of the machine, to be explained later. The only connections this compact mechanism has with the rest of the machine are through the racks, as already described, and through the action of these levers *Q*.

The Flexible Keyboard

The keyboard section of the adding machine is shown in two views in Fig. 10. It is built up entirely of screw machine and presswork parts, showing much ingenuity in its design. It forms a rigid, self-contained unit, which may be inserted in

the complete machine without difficulty. Although it is comparatively simple in construction, it has a wide variety of duties to perform. One of the most interesting points of the construction relates to the method by which the "flexible keyboard" effect is produced. A "flexible keyboard" is one so arranged that when a key has been depressed, it will stay down; but the pressing down of another in the same vertical column

Operation	No.	Rack	Accumulator Wheel	Type
To Print without Adding	1	Back to Key	.....	.....
	2	.....	.....	Print
	3	Forward to Zero	.....	.....
To Print and Add	1	Back to Key	.....	.....
	2	.....	Engage	.....
	3	.....	.....	Print
	4	Forward to Zero	.....	.....
	5	.....	Disengage	.....
To take Sub-total and Retain in Accumulator	1	.....	Engage	.....
	2	Back to Wheel Stop	.....	.....
	3	.....	.....	.....
	4	Forward to Zero	.....	Print
	5	.....	Disengage	.....
To take Total and Clear the Accumulator	1	.....	Engage	.....
	2	Back to Wheel Stop	.....	.....
	3	.....	.....	Print
	4	.....	Disengage	.....
	5	Forward to Zero	.....	.....

Fig. 8. Table showing Order of Movements for Different Operations on the Adding Machine

will release the first one. That is to say, but one key in a column can be depressed at a time, thus avoiding possible error. As a further advantage, when the wrong key has been pressed, the operator simply presses the right one and the wrong one is restored to normal position.

This effect is secured by means which are ridiculously simple. The principle is illustrated in Fig. 11. When the key 1, for instance, is depressed, the lower hooked end of the stem on which it is mounted springs past the end of a long pivoted strip *R*, which extends for the whole length of the vertical row of keys. Here the key is held by its hooked end. Supposing now the operator presses down on key 2. This also

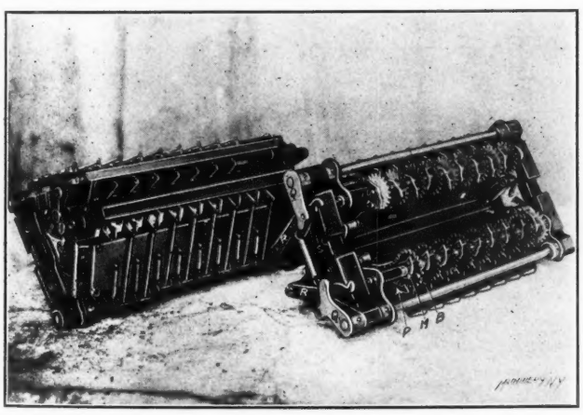


Fig. 9. Front and Rear Views of the Accumulator Section into which the Numbers are added

will open out the pivoted strip *R* to allow the hooked end of the stem to pass, and in so doing it will, of course, release the hooked end of key 1, which will immediately fly back in its normal position under the influence of spring *S*. Any key which may be pressed down will throw back strip *R*, and release any key which may be at the time depressed. One key *H*, the third from the left in the first row on the accumulator at the right, is shown depressed in Fig. 10, with its end hooked over the retaining strip in the same position as for key 1 in Fig. 11.

The keyboard is provided with interlocking mechanism connected with the controlling keys of the machine and with the operating lever. This mechanism, among other things, prevents the keys from being pressed down or changed after the operating lever movement is started. The keyboard also has a connection with an error key, the pressing of which releases all the keys that may be depressed at the time. This is operated by the strip shown extending across the base of the mechanism in the keyboard at the left of Fig. 10. It has also means for automatically releasing and returning the keys after each operation.

The Printing Section

The printing section is shown in Fig. 12, where it will be seen to be very much more complicated than is indicated by the simple diagrams shown in Figs. 5 and 6. The same parts, however, have been given the same reference letters, so that it will be possible to compare the engravings. This section, like that in Fig. 10, is built up entirely of screw machine and presswork parts, and is a very fine example of the combination of compactness and rigidity which is only attainable with such construction, in mechanism of this kind.

The added complication in Fig. 12 is due to a number of requirements. One of the most important of these is the "non-zero printing" action, which holds back all the zeros to the left of the last integer to be printed. By means of this mechanism, when we set up, for instance, "111.11" on the keyboard, the type will print that number instead of printing it 0,000,-111.11. Another provision is that of the rebound mechanism for the type, which allows it to strike the paper a hard blow and then quickly return. This gives clear printing without smearing or blurring the ink. Still another function that has to be taken care of is that of punctuating the numbers.

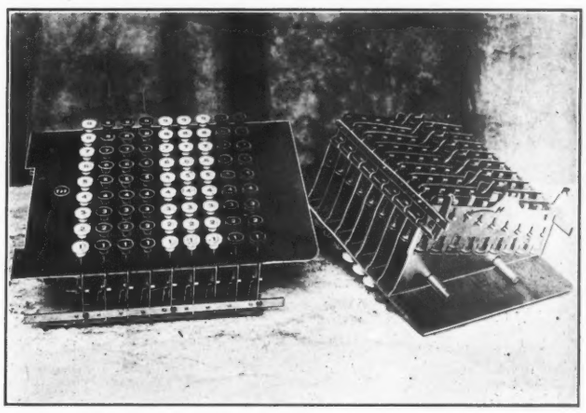


Fig. 10. Top and Bottom Views of Keyboard Section

This is controlled by the graduated slide shown just over the adding keyboard at the right of the machine in Fig. 1. By setting this slide, the numbers may be punctuated for units, for dollars and cents, and so on. When set to the graduation marked "X," the machine will add without printing at all. One of the punctuation characters is shown at *U* in Fig. 12.

It should be noted in Fig. 6 that there is enough mass to the parts of the printing mechanism to give a sharp blow of the type on the paper. This gives unusually good results in manifolding, this machine being equal in that respect to the best makes of typewriters. The ability to manifold through ten or a dozen thicknesses of typewriter and carbon paper is a new feature in adding machine construction.

The Reducing and Rack Section

In Fig. 13 is shown a top view of a machine partially dismantled. This view is given to show the arrangement of the typewriter mechanism for one thing, but more particularly to call attention to the "reducer" mechanism shown at *V*. In Figs. 5 and 6 it was shown that the racks *A* are connected with the type sectors *F* through a positive mechanism. Racks *A*, however, spread over the whole width of the machine while sectors *F*, as shown in Fig. 12, are concentrated in a small space. It is the office of these parts *V*, therefore, to effect this positive connection between the two differently spaced mechanisms. These levers correspond to the same part

marked *V* in the simplified diagrams Figs. 5 and 6, though, of course, the construction shown is different. At their lower ends they carry the arms making connections with the racks *A*, and also the tooth sectors shown at *D*, for registering the line of figures.

The Operating Mechanism

The best view of the operating section that can be obtained is shown in Fig. 14, where the right-hand side of the dismantled mechanism is illustrated. The principal provision

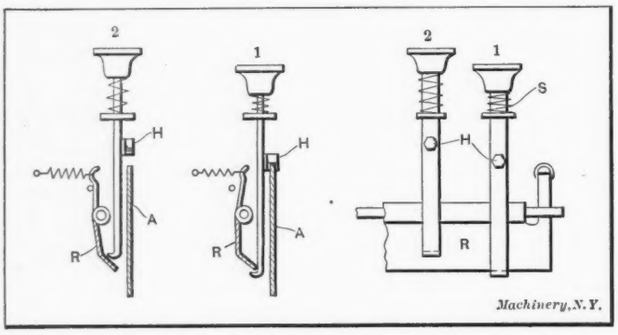


Fig. 11. The Principle of Operation of the Flexible Keyboard

which this mechanism has to take care of is that of safeguarding the more delicate parts of the machine from rough handling on the part of the operator. It causes the operation of the machine to take place under spring action at a certain known rate and with a known driving force. All the operator is allowed to do is to supply the power for stretching certain springs and releasing their action. He cannot directly apply his strength to the mechanism.

Fig. 15 shows this device. In position No. 1 the operator has just pulled the handle forward to commence operating the machine. This handle revolves freely on its shaft, the operat-

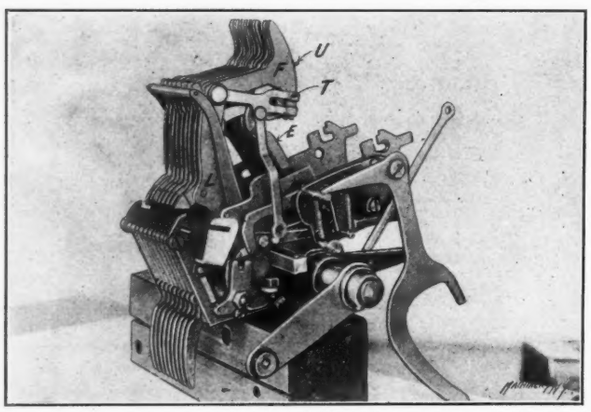


Fig. 12. The Printing Section

ing parts being driven by member E_1. As *Y* is pulled forward, catch C_1 releases pawl *Z* allowing member E_1 to fly forward by the contraction of springs A_1, through levers D_1 and links B_1. This free movement of member E_1 operates the forward stroke of the machine, and it is held to the proper rate of action by an oil by-pass governor, (shown best at G_1 in Fig. 13). Abutment F_1 stops this movement, in position No. 2.

The operating handle *Y*, which is now free of the mechanism, continues its forward movement under the hand of the operator until position No. 3 is reached. Here the tail of pawl *Z*, striking pin H_1, is thrown back into engagement again with the catch of member E_1. In moving the handle from position No. 2 to No. 3, spring A_1 has been extended, and it now acts through levers D_1 and links B_1 to return handle *Y* to the starting position, carrying with it member E_1 and the mechanism of the machine. This reverse movement is also under the control of the governor. Latch C_1 rises to permit pawl *Z* to pass, and the springs bring the whole back to position, all ready for a new stroke.

The double action of springs A_1 is very interesting. It will be seen that they operate the mechanism for both the forward and back strokes. This is made possible by the fact that they are connected to movable members at each end—in one case to levers D_1, and in the other case to operating handle *Y*. Their contraction to length *X* between positions No. 1 and No. 2, operates the forward motion, while their contraction from position No. 3 to position No. 1 operates the backward motion. The provision of two each of springs A_1, links B_1 and levers D_1, is simply for the purpose of balancing the strains in the mechanism.

Another interesting point to be noticed in connection with Fig. 14, is the double-acting pawl *J*. This makes it impossible for the operator to start a movement of the handle and not complete it. Handle *Y* is shown here at the commencement of the forward movement. Pawl *J* locks into successive notches on sector *K*, preventing its return until it has reached the final notch at the lower end. This is large enough to permit pawl *J* to reverse and turn in the other direction. This compels the handle to return to the vertical position, since it would lock again in the notches in sector *K* if any further forward action were undertaken. At the completion of this

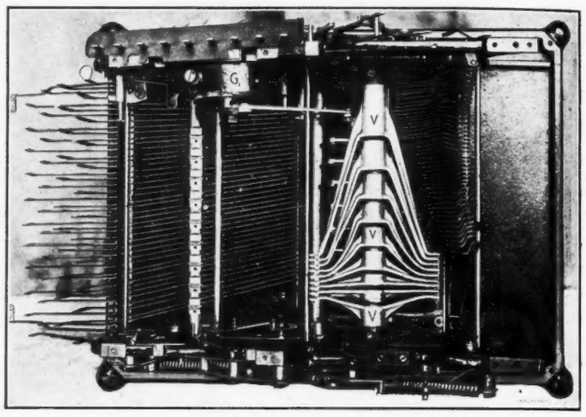


Fig. 13. Top View of Machine showing particularly the Reducer and Typewriter Sections

return stroke, *J* drops off the end of the sector, where it can again turn around for the forward stroke.

The Controlling Mechanism

Fig. 16 shows the most complex, and also one of the most useful sections of the machine. The stems shown projecting above the top of the keyboard at the right of the engraving are for the controlling keys shown at the left of the keyboard in Fig. 1. These are named, beginning at the top: "non-add," "debit add," "debit sub-total," "debit total," "credit add," "credit sub-total," "credit total," "repeat" and "error."

The pressing down of the non-adding key permits the print-

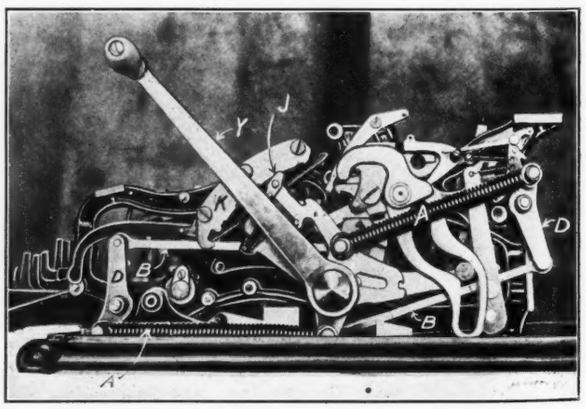


Fig. 14. Side View of Machine showing Operating Mechanism

ing of a number without adding, as explained in the first operation of the table in Fig. 8. In other words, this keeps the accumulators permanently out of engagement with the racks. The debit and credit add keys permit a number to be printed and added into the corresponding accumulator, even though the carriage is not set in the proper position for that accumulator. The use of these keys, therefore, gives a flexibility to the machine which is necessary for special operations such as horizontal adding. The debit and credit sub-total

keys take and print a total from either the debit or credit accumulators without clearing the accumulators, as illustrated and explained in Fig. 8. The debit and credit total keys, on the other hand, take the total from either the debit or credit accumulators, as the case may be, and clear the accumulator after the total is printed, as also explained in Figs. 7 and 8. The pressing down of the repeat key holds in the downward position whichever of the number keys have been depressed, allowing the same number to be repeatedly printed and added as many times as the operating handle is pulled. This is useful in multiplying by repeated additions, and for other similar uses. The pressing of the error key, as has been explained, will release every other key on the keyboard, both of the number keys and of the operating keys as well.

Now, the complexity shown in Fig. 16 is required for making the machine incapable of falsifying itself; that is to say, through it all the various functions of these keys so interlock with each other and with the operating parts of the machine, that it is impossible for an ignorant or careless operator to

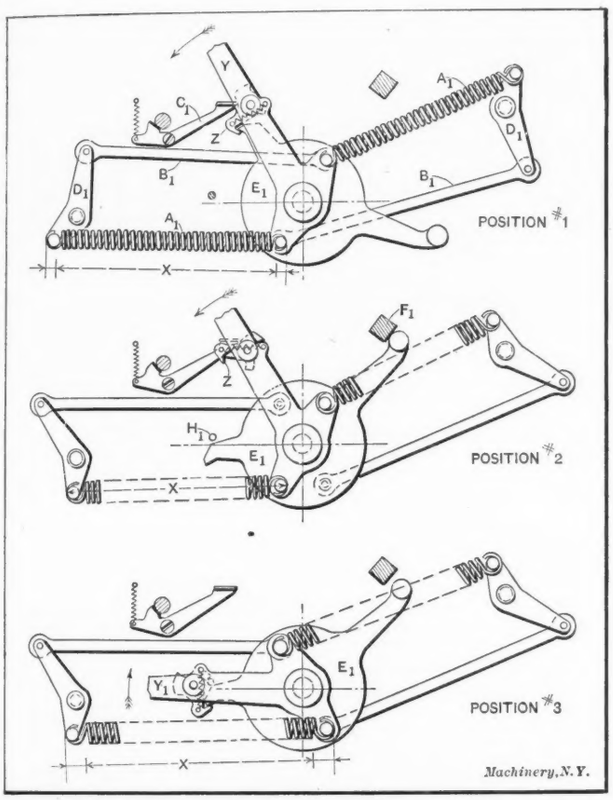


Fig. 15. Spring Control Device which safeguards the Delicate Mechanism from Rough Handling by the Operator

give wrong orders to the machine. The arrangement of the parts in this section required continuous concentrated thought on the part of the inventor, Mr. Ellis, and his assistant, Mr. Perkins, for nearly two years. The number of contingencies that had to be provided for seemed almost endless, and the amount of mechanism required seemed almost hopeless. By close study, however, the various functions were grouped, single parts were made to perform a variety of functions, and the whole range of connections was simplified so that this section has been reduced to the compact form shown herewith. It is hopeless, however, for a migratory editor or a casual reader to attempt to do more than get a vague notion of the work this section is called on to perform.

The Accumulator Controlling Mechanism

It may be worth while, perhaps, to get a notion of just how the controlling mechanism determines when the accumulators shall be thrown into engagement with the racks, and when they shall be released. In Fig. 17 sector K_1 is directly connected with the operating shaft L_1, controlled by the operating handle. It is provided with connections with both accumulators. Fig. 17 for convenience shows only the connections with the debit accumulator. Flying lever M_1 is connected with the debit accumulator by means of links O_1 and bell crank Q. Member P_1 is simply a spring detent to locate Q for either the engaged or disengaged position of the accumulator wheels.

As sector K_1 starts on its stroke toward the dotted position, it carries flying lever M_1 with it, owing to the resistance which the tail of the latter meets with against abutment R_1. When K_1 has gone far enough so that the tail has dropped off

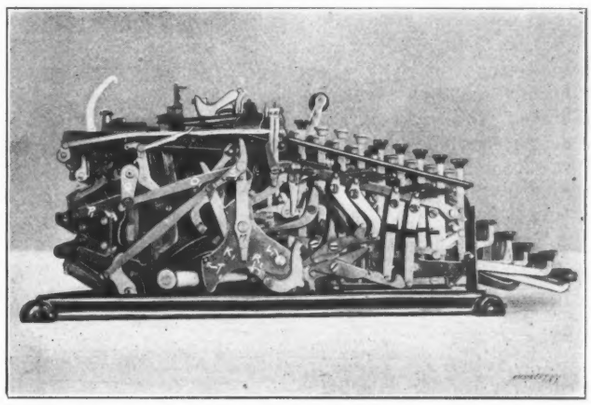


Fig. 16. Left-hand Side Frame Section for Controlling and Directing the Movements

R_1, flying lever M_1 becomes free. The movement has been sufficient, however, to move accumulator lever Q to position Q_1, which throws the wheels into engagement. If it had been desired to throw the wheels into engagement at the end of the stroke instead of at the beginning, detent R_1 would have been withdrawn from the position shown, leaving flying lever M_1 free. Near the end of the stroke of K_1, however, the end of the pawl S_1 would have struck stud T_1, making M_1 and K_1 solid, for all practical purposes, and moving Q to the position Q_1 at the end of the stroke.

If it had been desired to keep the accumulator wheels out of engagement altogether, R_1 would have been lowered out of the position shown, and S_1 would have been moved to a position clear of stud T_1. Then flying lever M_1 would have been entirely free of K_1, and no movement of Q would have taken place. The provisions for throwing the accumulator out of engagement at either the commencement or end of the return

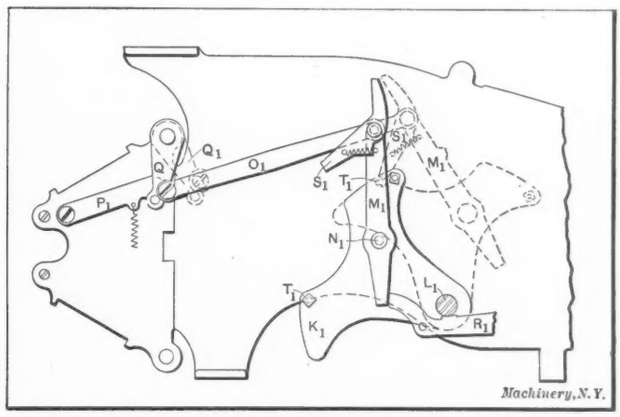


Fig. 17. Diagram showing Flying Lever Connection between Operating Shaft and Accumulators

stroke are similar to those just described, so need not be particularly referred to. This surely goes far enough into the mechanism of this controlling scheme for the average reader.

The Typewriter Mechanism

The various sections of the machine which relate to the typewriter mechanism are similar in principle to the corresponding parts on standard typewriters, though there are some added complications required for connections with the adding machines. The tabular, for instance, is provided with two kinds of stops, one of which is operated with the ordinary typewriter tabulator key. The other is located by latches on the tabulator scale, for setting the carriage at the proper position for the debit and credit columns, as determined by the

tabulator key on the adding machine keyboard. The white tabulator stop is for the debit column and corresponds with the white control keys at the left of the machine. The black stop corresponds to the black debit control keys. Except as previously described in connection with the controlling keys, the machine is locked to prevent debit adding unless the carriage is set for the debit accumulator, and the same is true for the credit accumulator.

The typewriter mechanism is best understood from the views shown in Fig. 13. The chief peculiarity of the machine as a typewriter is the compactness of the basket of keys, and the extreme length of the key levers necessitated by the interposition of the adding keyboard between the keys and the type. In spite of the handicap thus apparently placed on the typewriter mechanism, it appeared to the writer that the action of the machine was exceedingly agreeable—equal to that, in fact, of any machine with which he had ever had anything to do. This is in line with the inventor's express purpose to make the machine a good typewriter as well as a good adding machine. Diagrams showing the arrangement of the levers will be given in a subsequent article dealing with manufacturing operations.

Points in the General Design of the Machine

It is posible that, in reading the foregoing description, the reader may have been more impressed by the complexity of the mechanism than with the orderly arrangement which the inventor and designer have given to the parts. Without this orderly arrangement the machine would have been far more complex—so much so as to have been prohibitive. A rapid review may serve to make the orderliness of the arrangement a little clearer.

Looking at the machine from the front, the mechanism at the right, on the outside of the right-hand side frame, is entirely given up to the operating movements—that is, it is composed of parts whose movement is invariable. The parts on the left-hand side of the machine, on the other hand, are devoted entirely to such movements as are variable in their action at the option of the operator—that is to say, these are the parts which determine whether the machine shall print, add, or take sub-totals, totals, etc. All the space between the frames is filled with mechanism which does the actual work of calculating, as directed by the left-hand side mechanism, and as operated by the right-hand side mechanism.

To put it in another way, the machine may be considered as a manufacturing organization with the executive offices at the right-hand side, the sales or order-taking department on the left-hand side, and the shop itself—which delivers the goods—in the main part of the structure. This segregation of the different functions results in shorter connections throughout between the various moving members, reducing the number of parts to a remarkable degree.

The designer of an adding machine has to do much more than make a machine that shall add correctly. He has to make a "fool-proof" machine, one that the operator cannot put out of business by roughness or carelessness. We have shown some of the features of the machine which render it proof against error from this cause. But the designer has to do still more than this. He has to make it what might be termed "villain-proof," as well as fool-proof. The necessity for this is due to the peculiar conditions under which the adding machine works.

When an adding machine is used, implicit confidence is placed in it. It may be permissible for a bookkeeper to make a mistake once in a while in adding a column of figures, but no excuse is ever listened to if an adding machine makes a similar error. The adding machine salesman knows this, of course, and it is part of the stock in trade of some of them, when the opportunity offers, to show how a rival machine may make a mistake. Now in all probability, in order to force the machine to make a mistake, he will have to do something that the operator would not by any possibility think of doing, unless he actually set out to do it, and knew exactly how to go about it. This, however, the intending purchaser may not stop to think of. He sees that the machine may be made to make a mistake and so he loses confidence in it.

The designer of an adding machine, then, has to provide all sorts of safeguards to prevent willful misoperation of the mechanism. Without explaining in detail the precautions of this kind taken in the machine we are considering, it may be well to make note of one of them. In some machines it is possible, by pressing a key part way down, to get an undesired result; the pressing of the key part way down may affect part of the change in the control of the mechanism desired, while it may require the full movement to produce the whole result desired. In order to avoid this difficulty, particularly in the matter of the left-hand row of operating keys, the action of these keys has been made "permissive" only; that is to say, when these keys are pressed down, as best seen in Fig. 16, they allow the bent ends of certain levers to snap into place in notches cut in the sides of the stems. Now the ends of these levers have either snapped into place in the notches, or they have not. There is no halfway position, and there is no possibility of fooling the machine on that account. A good deal of the mechanism provided in Fig. 16 is required to prevent the possibility of willful mismanagement of the machine.

The writer asked Mr. Ellis, the inventor, the reason for the plate-glass windows which the adding machine builder is accustomed to place in the sides of the frame of his product. The explanation offered was that the customer was thereby enabled to see that he had gotten his "money's worth" in mechanism. With the detailed views of the machine here given, there should be no further doubt on this matter in the mind of the reader. In fact, he might well wonder how the manufacturer can afford to sell so much complication for the paltry hundreds of dollars he asks for it. Articles on manufacturing operations in succeeding numbers of MACHINERY, will, perhaps, let a little light into this dark mystery.

* * *

SAG AND STRENGTH OF MANILA POWER-TRANSMISSION ROPE

The sag and strength of manila rope cannot be determined exactly, as it varies with the load carried, the speed run, and the initial tension in the rope. In the multiple system, when the slack comes on top, the rope is allowed to sag until parts running in opposite directions would nearly touch. It then has to be shortened. The sag on the tight side may be determined quite closely if the exact power to be carried is known. Likewise, in the continuous system, where it is possible to keep a uniform tension on the rope, the sag may be closely approximated. In general, a rope should be allowed to run as slack as possible without slipping.

The sag of ropes takes nearly the form of a parabola. The amount may be approximated by multiplying the weight of one foot of rope by the square of the distance from sheave to sheave where the rope leaves, and dividing by eight times the tension on the rope. For example, the sag of Plymouth two-inch diameter rope supported ninety feet apart, running at four thousand two hundred feet per minute is $\frac{1.34 \text{ pounds} \times 8100}{8 \times 800}$ = 1.7 feet on the driving side, which would be the same at all speeds. The slack side sag may be determined after the same method, by adding to the initial tension the tension from centrifugal force. Thus, with the same rope as before

$$\frac{1.34 \times 8100}{8 \times 199 \text{ pounds initial} + 205 \text{ centrifugal tension}} = 3.3 \text{ feet.}$$

A new rope will stretch considerably for a short time, but after the parts of the rope are firmly bedded together further stretch is slow. The total stretch should not exceed five per cent under reasonable conditions. In cutting the slack out of continuous drives, it must be borne in mind that some movement of the tightener sheave must be allowed for shrinkage caused by atmospheric conditions and future resplicing.

* * *

It is stated by the United States Consul at Rio de Janeiro that the president of the Central Railroad of Brazil proposes to send to the United States groups of four mechanics each, every six months, to work in a large locomotive-building plant in this country which is furnishing locomotives to this railway. In this way it is proposed to educate a number of men in American locomotive-building methods.

MULTIPLE CUTTER TOOLS

By W. S. GIELE*

The writer has, in conversation with many practical men, encountered such widely differing opinions on the relative advantages of boring and turning tools made with single and with multiple cutting edges, that he offers his own experiences with such tools. Many men seem to hold to the belief that far more accurate work is produced by the single cutting edge than can be produced by tools having multiple cutting edges, and they are usually able to support their position by showing work of the highest excellence made with single cutters, and probably plenty of work which is decidedly not of the highest excellence made with multiple cutters.

Some experience in the manufacture of machines which required multiple cutters and the design and purchase of a number of cutting tools used in the manufacturing processes, has led the writer to analyze some of the problems involved, with the very commonplace conclusion that in this, as in everything else, there are situations where one type of construction is best adapted, and other situations where a different type of construction is best adapted. Neither is it particularly original to say that in the final analysis, the terms of the problem must be reduced to dollars and cents.

The most ardent advocate of multiple cutters will probably continue to turn up his occasional lathe job with a single tool in the tool-post, and to bore out his jig holes with a single pointed boring tool, because that is really the best way; not that it might not be done just as accurately and as well some other way, but because that is generally accepted as the most *economical* way to do the job sufficiently well. On the other hand, the man who firmly believes in the single cutting edge, will probably continue to use twist drills with more than one lip, taps and reamers with more than one flute, threading dies with more than one cutting edge, hollow mills with more than one tooth, and very likely more than one cutting edge in his cutting-off machine. And his reason for doing all these things is, again, not because he has no choice, but because he is following what has been accepted as the most economical way.

Whenever multiple cutter tools have failed, it is reasonable to inquire whether each of the cutting edges has been ground with the same care and precision as a single cutting edge would have been, and whether the drive, the feed, the support, and the piece on which the work was being done all had the same relative rigidity in proportion to the amount of metal being removed in the case of the multiple cutter, as in the case of the single cutter. The problem is not what can be done, but what will it pay to do.

As a concrete illustration, let us suppose a line of headstocks in which the spindle bearings are to be bored, varying, in a case which the writer has in mind, from 4½ to 17 inches in diameter of bore, each headstock having two bearings of the same diameter and in line with each other. The material is cast iron, and the bearings have caps of the usual form with liners varying in thickness from 1/16 to ⅛ inch according to the bore. Boring-bars or arbors are made for each size of headstock. These bars are made as short and as large in diameter as the clearances will allow, to gain the maximum stiffness in proportion to the amount of work to be done. On each bar are mounted two roughing, and two finishing heads so spaced that the two bearings will be rough bored simultaneously, and finish bored simultaneously. The roughing and finishing heads are so spaced, relatively, that the finishing tools do not come into action until the roughing tools have completed their cut.

Without discussing here the relative advantages of an odd number of cutters and an even number, it is evident that this is a job for an odd number, as with an even number, equally spaced, there would be two cutters jumping a liner gap at the same instant.

In this case, the roughing heads have three tools each, all standing in the same plane perpendicular to the axis of rotation and with equal angular spacing. The tools have ample clearance and rake, being shaped much like a round-nosed roughing tool for a lathe. These tools are jig ground and abut against wedges or taper keys, which are graduated so that it is possible to set the tools with ample exactness for rough boring, without calipering. They do the cutting on the leading side and not on the circumference. The finishing heads have a varying number of inserted cutters according to size of hole. The largest has nineteen cutters. These tools cut on the leading corner and also take a slight shearing cut on the circumference. They vary in length parallel to the axis of rotation in the different heads, but are all set at such an angle that the arc embraced between the radii to the front and back corners is equal to about three times the liner gap. They are, in fact, equivalent to the teeth of a left-hand helically (commonly called spirally) fluted reamer. They are ground to size in place and gaged to limits. The holes they produce are sufficiently accurate, both as to size and finish, to run as bearings without scraping.

In feeding any boring tool through the work, a point on the cutting edge passes through the hole in a helical path and its trace as marked on the work appears as a shallow screw thread. The apparent roughness of the finish left by the tools depends on the depth and pitch of this thread; that is, the finer the pitch, the smoother the finish appears. The time for cutting a given length of hole, however, depends on the lead of the thread, other things being equal. To increase the lead without increasing the pitch, it is necessary to produce a multiple thread. In other words, for any given pitch or width of tool marks on the work, it is possible to increase the lead or feed in direct proportion to the number of cutting edges and cut down the time required to feed a given length in inverse proportion. Thus a feed of 3/16 inch per revolution with a three-cutter head, gives a pitch of 1/16 inch to the tool marks, whereas the same feed applied to a single cutter would result in a 3/16-inch pitch in the tool marks, and if the depth of metal removed is the same, the single cutting edge would have to remove three times as much stock as each cutter in the multiple tool head, and would leave a rougher finish.

It is important to remember, when making multiple cutter heads, that the clearance and rake angles on the leading or cutting side are determined by the lead or feed and not by the pitch. These angles depend on the angle between the helical path of a point on the cutter and a plane perpendicular to the axis of rotation which is easily found, being the angle whose tangent equals the feed per revolution divided by the circumference of the hole.

As far as the matter of design is concerned, the number of cutters in a head is limited only by the chip clearance which will be left between cutters and the space required between cutters for the means which holds them in place. The design of the head itself is, however, not the only factor to be considered, as the limit may be set by the rigidity of the machine it will be used on, or the strength of the drive and feed, or the strength and stiffness of the piece being worked on. The ultimate limit which governs all others must, however, always be the economic one.

The larger the number of cutters in a head, the shorter will be the cutting time for any given length of hole; and also the higher will be the initial cost. Offsetting the higher initial cost is the fact that with a multiple cutter head each individual cutter does an amount of work inversely proportional to the number of cutters, and the head as a unit will therefore have an endurance, in number of holes bored between grindings and total number of holes bored during its life, proportional to the number of its cutters. Even where the total number of holes to be bored is very large, the higher initial cost of the multiple cutter head may not be easily justified if the distance to be bored is very short or the setting-up time is a very large proportion of the total time, because in such cases a saving of two-thirds or four-fifths, or a larger proportion of the boring time, may still represent a very small proportion of the total time.

To sum up: The number of cutting edges in a boring or turning tool (which may also be made to include tools for internal or external threading) is governed principally by the following considerations:

1. Number of pieces to be machined.
2. Proportion of cutting time to total time of operation.
3. Rigidity of pieces worked on.
4. Capacity of drive and feed.
5. Chip clearance between cutters.
6. Space required for means to hold the cutter.

* Address: 3303 N. Gratz St., Philadelphia, Pa.

ECCENTRICALLY LOADED BOLT AND RIVET GROUPS

By M. TERRY*

The eccentrically loaded rivet group problem discussed by Mr. Gwinner in the May issue of MACHINERY is one of the cantilever class. As a mathematical proposition the cantilever problem is analyzed as follows: In Fig. 1, O is the point of support of any object, A is any point outside of it to which a force $(+W)$ is applied. R is the perpendicular distance from O to the line representing the direction of the applied force. Now, if two forces $(+W)$ and $(-W)$, each equal to the force W at A, and parallel to it, are introduced at O, the situation remains unchanged; but the forces $(+W)$ at A and $(-W)$ at O can be combined into a couple whose numerical value is

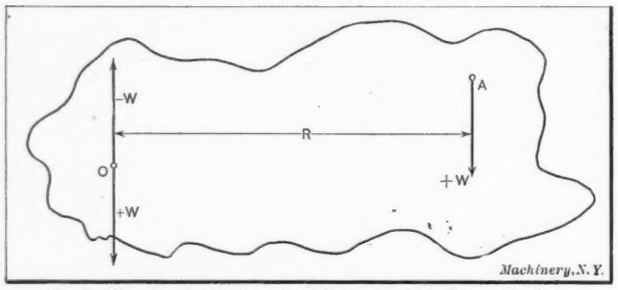


Fig. 1. Diagram for Mathematical Analysis of Cantilever Problem

$W \times R$. Thus a single force W applied to a body at a distance R from its center of support is equivalent to the same force W applied in the same direction at the point of support, and a couple or moment WR.

In every practical problem of this nature the direct force W is usually considered equally distributed among the various bolts or rivets that make up the group. The bending moment WR is balanced by the resisting moment of the rivets, and only those rivets play an active part in resisting the bending moment that are placed outside the geometrical center of the group, *i. e.*, those that are "possessed of an arm."

In the following, let

M = bending moment produced by the eccentric load,

f = actual shear per rivet due to the eccentricity of the load,

R = radius of the bolt or rivet circle,

n = number of rivets located on the same circle,

Then

$$n \times f \times R = M$$

$$f = \frac{M}{n \times R}.$$

If n and M remain constant, f varies inversely as R. Hence

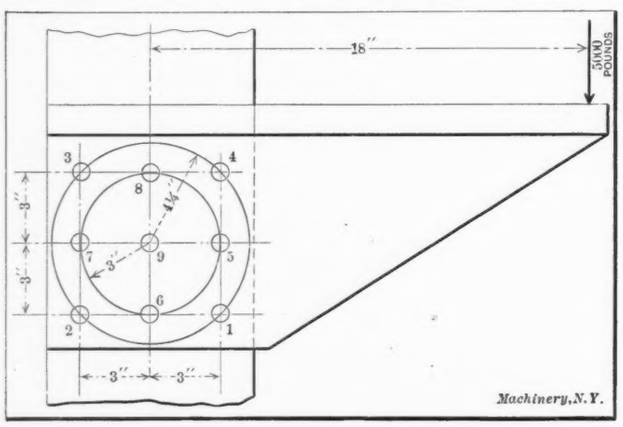


Fig. 2. Eccentrically Loaded Rivet Group

in Fig. 2, where n is the same for both circles, and M equals 90,000 inch-pounds, we have:

$$\frac{\text{Actual shear on inside rivets}}{\text{Actual shear on outside rivets}} = \frac{4\frac{1}{4}}{3} = \frac{17}{12}$$

If x equals total shear on the outside rivets, then $\frac{17}{12}\,x$ equals total shear on the inside rivets, and

$4\frac{1}{4}\,x$ = resisting moment of outside rivets,

$\frac{17}{12}\,x \times 3 = 4\frac{1}{4}\,x$ = resisting moment of inside rivets.

The total resisting moment = bending moment = $8\frac{1}{2}\,x$ = 90,000 inch-pounds. Hence,

$$x = \frac{90{,}000}{8\frac{1}{2}} = 10{,}588 \text{ pounds},$$

$$\frac{10{,}588}{4} = 2647 \text{ pounds} = \text{shear per outside rivet},$$

$$2647 \times \frac{17}{12} = 3750 \text{ pounds} = \text{shear per inside rivet}.$$

The direct load of 5000 pounds is equally distributed among the 9 rivets, producing a shear of 555 pounds per rivet.

The total shear on any rivet is the geometrical sum of direct and tangential shear. Referring to Fig. 3, it is clear that rivet No. 5 is in greater stress than any of the rest, having a total shear of 4305 pounds. Taking, as Mr. Gwinner did, 10,000 pounds per square inch as the safe shear, a $\frac{3}{4}$-

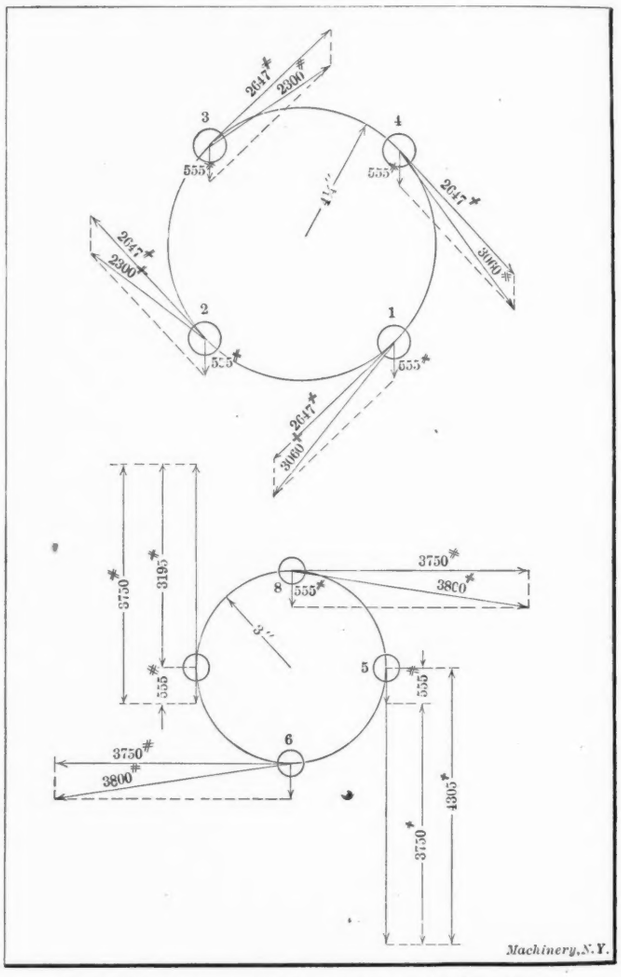


Fig. 3. Stress Diagrams for Eccentrically Loaded Rivet Group

inch rivet can be safely stressed to 4400 pounds. The shear on rivet No. 5 then is just within the safe limit. Since a $\frac{5}{8}$-inch rivet has a safe shear of about 3060 pounds, a set of four $\frac{5}{8}$-inch rivets can be safely used on the outside circle, if desired.

Let us now take the simple case shown in Fig. 4, and deduce the principles involved in designing a well-proportioned joint. The joint in question is likely to fail in any or all of the following three ways:

1. Rivets may fail by shearing.
2. The plate A may be too thin, making the bearing value too high, and causing the metal in the plate to "flow" at the rivets.
3. The plate A might fail at its weakest section, which is in the plane of the rivets.

* Address: 302 Williams St., Flint, Mich.

"No chain is stronger than its weakest link," and if the weakest link is strong and safe enough for its load, there is no necessity for making other links stronger. An ideal joint is one designed in accordance with this principle, but like many other ideal things it is seldom carried out in practice. Usually, the width and thickness of plate are assumed, rivets calculated, and then the plate examined for safety in bearing and bending. This method might give us, say, a factor of safety of 7 for shear, 9 for bearing and 11 for bending. Sometimes this is the best that can be done even when considerable time is spent in calculations. For instance, if we try to reduce the too high factors of safety in bearing and bending, by making the plate thinner, we may arrive at some

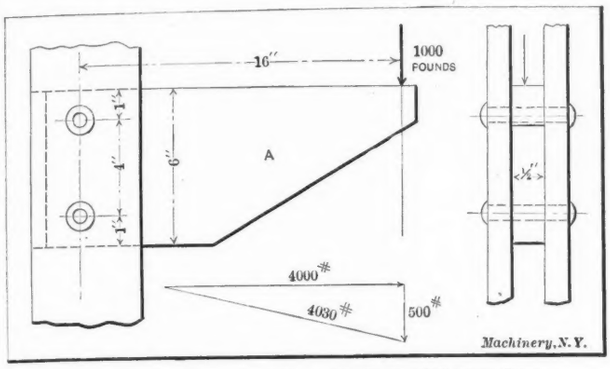


Fig. 4. Another Example of Eccentrically Loaded Rivet Group

odd-size plate which, as a manufacturing proposition, is out of the question.

In Fig. 4:

M = bending moment = $1000 \times 16 = 16{,}000$ inch-pounds,

F = tangential shear per rivet,

r = distance between rivets = 4 inches,

Resisting moment = bending moment.

$$F \times r = M,$$

$$F = \frac{M}{r} = \frac{16{,}000}{4} = 4000 \text{ pounds.}$$

Assuming that the direct load is equally supported by the two rivets, the total shear per rivet = $\sqrt{4000^2 + 500^2} = 4030$ pounds, which is also evident from the graphical solution in the lower part of Fig. 4.

Taking 10,000 pounds per square inch as the safe shear, and remembering that the rivets are in double shear, we have

$$\frac{\pi D^2}{4} \times 2 \times 10{,}000 = 4030,$$

$D = 0.51$ inch = diameter of the rivets.

One-half-inch rivets would be used in practice. This apparently exceeds the safe limit by about 2 per cent. Such slight excess is permissible, and even if the excess amounts to from 7 to 10 per cent, we need only remember that holes are drilled 1/32 inch larger, and the rivet after being driven in place will be 17/32 inch in diameter.

The bearing pressure is calculated on the projected area of the hole, and the safe unit stress for good structural steel can be taken at 20,000 pounds per square inch. The projected area of the hole = ½ × ½ = ¼ square inch. 20,000 × ¼ = 5000 pounds = safe pressure.

The actual pressure amounts to 4030 pounds.

Next and last comes the question of the strength of the plate.

M = bending moment = 16,000 inch-pounds,

y = distance from neutral axis to the top fiber = 3 inches,

I = moment of inertia of the section in the plane of rivets = 7,

f = actual tension per square inch in extreme fiber =

$$\frac{My}{I} = \frac{16{,}000 \times 3}{7} = 6857 \text{ pounds per square inch,}$$

which is well within the safe limit for structural steel.

There is one more manner in which this joint may collapse; this would be due to cutting off the plate too close to the edge of the rivet holes. The plate would then collapse at the upper rivet. By locating the rivets at from 2 to 3 times their diameter from the edge of the plate, one need not fear any trouble from that source.

* * *

TO DIVIDE A TRAPEZOID INTO EQUAL AREAS

By M. F. JACKSON

While in the pattern shop the other day I noticed several of the men in a heated argument over something and paused to discover what the bone of contention might be. It was an old problem about a tapered plank and where to cut it in order to have two parts of equal areas. Joe proposed to draw lines diagonally across the plank from one corner to the other, and cut the plank in two at the intersection of these lines, while George thought it best to balance the plank on the edge of a steel square, thus finding the center of gravity; for, said George: "There must be as much material on one side of the center of gravity as on the other." As a matter of fact, a student in geometry would know that Joe was wrong, as would also a student of mechanics who understood the principles of moments, know that George was also wrong; nevertheless, each had his adherents, and as the discussion was likely to be prolonged, I volunteered to work it out for them. The statement, solution and proof follow:

A patternmaker has a plank of mahogany in the form of a trapezoid (see Fig. 1) 12 feet long, 12 inches wide at one end and 9 inches at the other. He wishes to cut it into two parts of equal areas. How far from the small end must the center of the saw-cut be to effect an equal division; that is, what is the value of x?

Solution: The total area of the plank = $\frac{9+12}{2} \times 144 =$

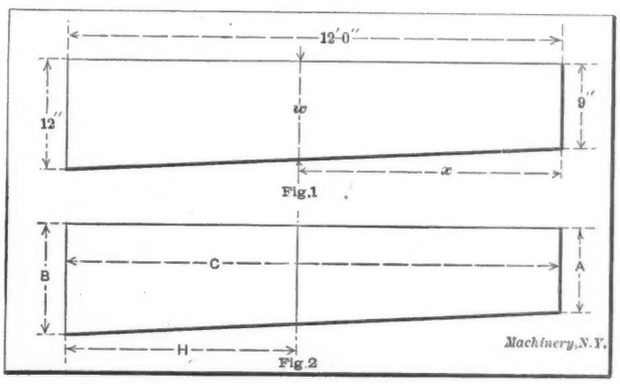


Fig. 1. Plank to be cut into Two Parts of Equal Areas. Fig. 2. Trapezoid giving Notation used in Formula

1,512 square inches and one-half of the area equals 756 square inches.

The taper per inch is $(12 - 9) \div 144 = \frac{1}{48}$ (1)

The width of the plank at the saw-cut is $w = 9 + \frac{x}{48}$ (2)

The area of the narrow end is $\frac{9+w}{2} x$; but this must equal 756 square inches. Therefore $\frac{9+w}{2} x = 756.$ (3)

Inserting in (3) the value of w as given by (2), we have

$$756 = \frac{9 + 9 + \frac{x}{48}}{2} x = 9x + \frac{x^2}{96} \quad (4)$$

Multiplying both sides by 96 gives

$$96 \times 756 = 96 \times 9x + x^2 \text{ or } 72{,}576 = x^2 + 864x \quad (5)$$

adding $\left(\frac{864}{2}\right)^2 = 186{,}624$, to both sides to complete the square gives

$$72{,}576 + 186{,}624 = x^2 + 864x + 186{,}624 \quad (6)$$

Extracting the square root

$\sqrt{259{,}200} = x \pm \sqrt{186{,}624}$ or

$x = \sqrt{259{,}200} \pm \sqrt{186{,}624} \pm 509.177 \pm 432$ or

$x \cong 941.117$ or $x \cong 77.117$ inches, the latter being the value sought.

Proof: Inserting this value of x in (2), we have $w = 9 + \frac{77.117}{48} = 10.6066$, and area of end $= \frac{10.6066 + 9}{2} \times 77.117 =$ 756.001086, the slight excess being due to the decimals.

[The formula $H = \frac{C}{B-A}\left(B - \sqrt{\frac{A^2+B^2}{2}}\right)$ the notation of which is indicated in Fig. 2, may be used for dividing a trapezoid into equal areas.—EDITOR.]

* * *

REPAIRING AND IMPREGNATING COILS

By RALPH W. DAVIS*

To a person who is not familiar with the methods used in electrical construction, the question of insulation appears to be complex and difficult, so a short account of the modern procedure may be of interest.

The coil shown in Fig. 1 happened to be a repair job, but new work follows the same line of treatment. The great size of this coil, which is one of a set for a 4000 volt, series arc transformer, can be judged by a comparison with the 3-foot rule that is suspended before it. The cost of repairing the coil by the method to be described was only about one-seventh the cost of a new one. Of course, when repairing, the largest item of first cost, which is that of the copper, is eliminated, and there is, practically speaking, only the labor cost, which depends largely on the extent of the injury.

The process of repairing this coil was as follows: The coil, when received, was carefully measured, after which it was torn

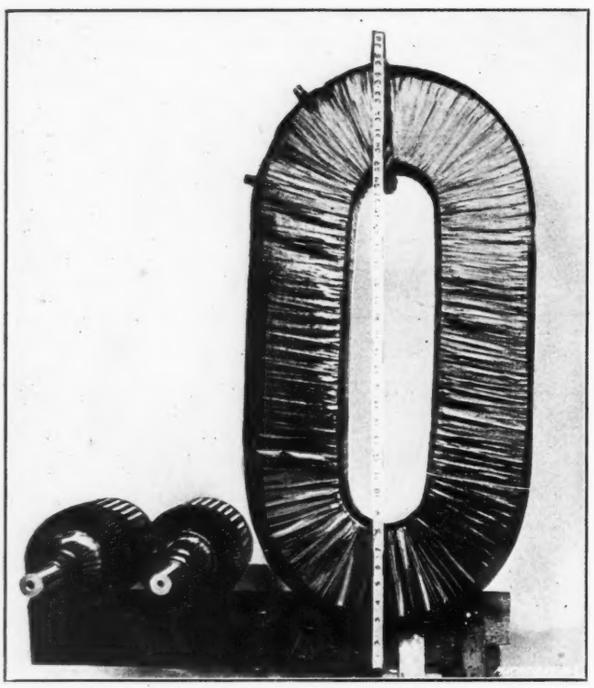


Fig. 1. Large Transformer Coil

apart or "unwound," and all injured wires repaired. It was then formed up again by winding over a wooden form made to the recorded dimensions. The winding is usually done in a worm-driven winding lathe. The re-formed coil was then removed from the form and wound with cotton tape and the terminals put in place and insulated. After all metal parts were carefully covered with adhesive tape, the coil was ready for the bath in the impregnating compound.

It is necessary that the coil be subjected to a high drying heat for about six hours, the temperature being kept at 335 degrees F. It is then placed in a vacuum chamber, where a 29½-inch vacuum is maintained by means of a pump having a water-cooled condensing chamber. All moisture is thus expelled and the coil is absolutely dry and ready for the liquid portion of the bath. This liquid is a combination of several good insulating and moisture resisting elements. In Fig. 2, the cylinder at the left is the liquor chamber where the compound is mixed and heated until it reaches the proper constituency. At the right, and connected to the liquor chamber, is the impregnating chamber, in which the coils are suspended by means of a specially designed rack that keeps each coil separate from the other. The compound, at a temperature of 340 degrees F., is "run over" from the liquor chamber, and a pressure of 70 pounds per square inch is

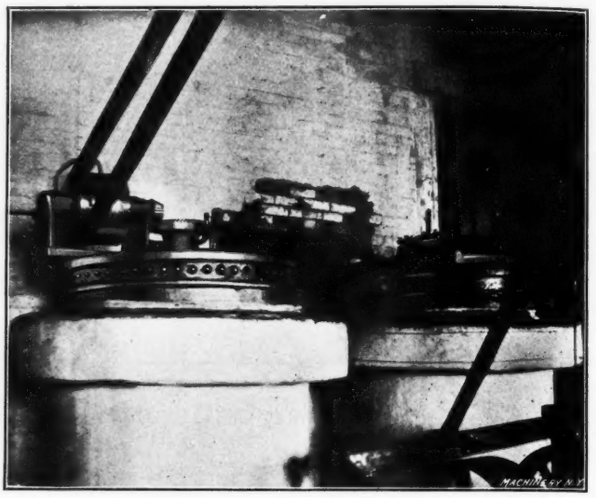


Fig. 2. Tanks in which Coils are impregnated with Insulating and Moisture-resisting Compound

applied to the impregnating chamber by means of a small combination vacuum pump and compressor.

Under this condition the coil is kept for eight hours, allowing the compound to penetrate to every portion of the winding, and by reason of its high insulating quality, it places additional insulation between the winding. Actual tests snow an increase of 100 per cent. The compound also acts as a preservative on the tape and cotton insulation, and the coil is firm and solid. After being removed from the bath and drained, the coil is jet black, but a covering of a more pleasing color may be added if desired.

This treatment is especially useful for armatures and field windings that are subject to moisture or hand usage, such as would be received in steel mills, coal or iron mines and outside construction. The small armatures are impregnated after the windings are in place, while large armatures have each coil treated before being placed in position.

A complete impregnating outfit for ordinary work can be bought and installed for $700, while larger sizes, of course, are more costly. An outfit which will handle 2500 pounds of railway field coils at one time will cost about $1,350. Fig. 2 shows the liquor and vacuum chambers of a plant of this size. Note the heavy asbestos heat insulation and also the massive covers. The mechanism on top of the liquor chamber (at the left) operates the mixing blades. The combination vacuum pump and compressor, previously referred to, first obtains the vacuum needed, and then by an arrangement of bypasses and piping, the same pump provides the required pressure. The chambers are usually heated by steam, which is admitted to the jacket about the chambers, but where steam is not available, the jacket is filled with high flash oil heated by a gas burner, and kept in circulation about the chambers.

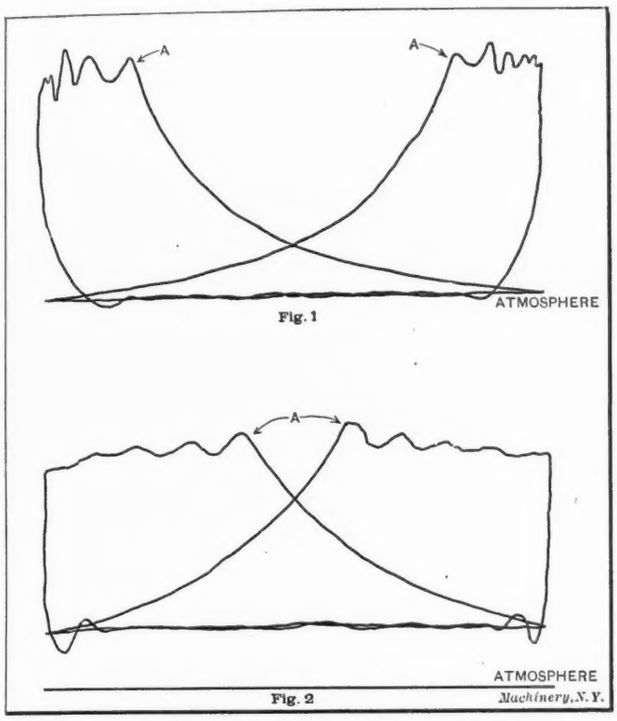
The impregnating compound is a commercial article made by several companies, and it is in several grades. The point at which it will soften and begin to drip determines the particular grade to be used, as some coils are subject to greater heat than others, but with all grades the action of the vacuum to take out all air pockets, followed at once by the immersion in the heated compound under pressure, insures every portion of the coil's receiving its portion of the compound, which rarely happens with the old method of dipping in varnish.

* Address: 227 Columbia Ave., Rochester, N. Y.

COMPRESSED AIR RECEIVERS

By G. J. MacFADDEN*

An air receiver plays an important part in obtaining the highest efficiency and most economical operation of any compressed air installation. It is essential that the cubic capacity of the receiver be in the right proportion to the capacity of the compressor. For all practical purposes the receiver should have a capacity of from 15 to 20 per cent of the free air capacity of the compressor (per minute), but in large installations the percentage is sometimes lower, running down to about 10 per cent. To obtain good results the receiver should be placed as near as possible to the compressor, and in any case not more than 50 feet distant.



Figs. 1 and 2. Typical Indicator Diagrams from Single-stage and Two-stage Air Compressors

Receivers may be placed in either a vertical or horizontal position, the vertical being preferred in most cases owing to the economy in floor space thus obtained. In many cramped installations the receiver is suspended from the ceiling by means of hangers or on the wall by means of brackets.

On entering the receiver, the discharge air from the compressor is reduced in velocity, and cooled to a certain extent, a large percentage of the oil and moisture held in suspension being deposited thereby, giving a relatively dry and clean air at the machines and tools using same. The inlet and outlet openings should not lie in a straight line opposite each other, as a through current would result which would interfere with efficient cooling and depositing of the moisture; the usual practice is to take the air in at the top and discharge it at the side near the bottom where the air is cooler, thus causing a change in the direction of flow and allowing of more efficient cooling and depositing of the moisture. Atmospheric conditions affect the amount of moisture deposited, and the receiver should be drained often in warm weather.

If the air from a compressor were discharged directly into the main, a loss of power would result, due to the piston of the compressor forcing a cylinder full of air into the main against a pressure momentarily higher than the normal. In other words, the effect of the strokes of the compressor piston would be to set up pulsations and cause fluctuations in pressure. This action would also have a tendency to increase the friction in the discharge pipe.

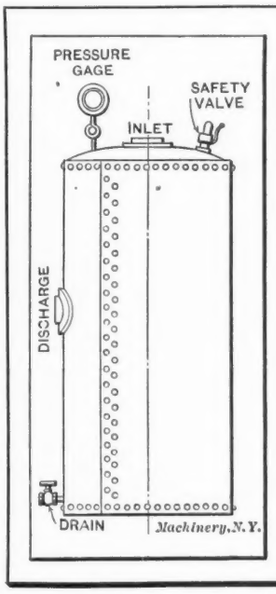
In comparing the pulsations caused by the discharge on a single-cylinder and a multiple-cylinder stage compressor it will be noticed that the latter has less pulsation to a marked degree, on account of the discharge valves opening sooner in the stroke and producing a longer duration of discharge. Fig. 2 illustrates this to good advantage, being an indicator card from a two-stage compressor, the card being taken from the high-pressure cylinder, 10 inches bore, compressing to 100 pounds per square inch gage. The points marked *A* show the commencement of discharge, and it will be noted that about one-half the stroke is utilized for it. The discharge valves of a single-cylinder compressor working at the same pressure open much later in the stroke, causing the total discharge to occur during a shorter part of the stroke, thus setting up a violence of discharge pulsations.

Fig. 1 shows a card from a 10-inch bore single-cylinder compressor, compressing to 100 pounds gage. The points marked *A* show the opening of discharge valves, and by comparing with Fig. 2, it will be seen that the duration of discharge is very much less in Fig. 1.

The receiver, if the capacity is sufficient, prevents any appreciable rise or fall of pressure due to the discharge of air and absorbs all pulsations. In regard to the receiver acting as a reservoir of power, this is true only to a certain limited extent; the storage feature can be of much value only in certain cases, such as in small plants where an exceptionally large receiver is employed in connection with a small compressor, the compressor being operated only long enough to raise the air to the desired pressure in the receiver, then being shut down, and the air used from the receiver to operate pneumatic tools or machinery which would allow a variation in working pressure of from 20 to 40 pounds, permitting the pressure to drop to that extent in the receiver before the compressor is put into operation again.

In the common form of receiver construction, steel of 60,000 pounds per square inch tensile strength is used; all circular seams are single-riveted and the longitudinal seams double-riveted. The heads of vertical receivers are usually dished, one being concave and the other convex, and in the case of horizontal receivers both heads being convex. Air inlet and outlet flanges, tapped holes for the pressure gage, pop safety valve and drain cock should be provided in the right proportion to suit the capacity of the receiver, always placing the drain cock at the lowest possible point to allow complete drainage of all moisture and lubricating oil deposited by the

DIMENSIONS OF VERTICAL AIR RECEIVERS



Diameter of Receiver in Inches	Height in Feet	Thickness of Shell	Thickness of Head	Inlet and Outlet	Diameter of Safety Valve	Cubic Contents in Feet	Weight	Compressor Capacity for which Receiver is best adapted
24	5	$\frac{1}{4}$	$\frac{1}{4}$	2	1	16	510	75 — 100
24	6	$\frac{1}{4}$	$\frac{1}{4}$	$2\frac{1}{4}$	1	19	580	100 — 120
30	5	$\frac{1}{4}$	$\frac{1}{4}$	3	$1\frac{1}{4}$	25	630	110 — 140
30	6	$\frac{1}{4}$	$\frac{1}{4}$	3	$1\frac{1}{4}$	30	720	120 — 150
36	6	$\frac{1}{4}$	$\frac{1}{4}$	3	$1\frac{1}{2}$	42	950	150 — 200
36	7	$\frac{1}{4}$	$\frac{1}{4}$	3	$1\frac{1}{2}$	50	1050	160 — 210
36	8	$\frac{1}{4}$	$\frac{1}{4}$	$3\frac{1}{4}$	$1\frac{1}{2}$	57	1150	200 — 300
42	7	$\frac{1}{4}$	$\frac{1}{4}$	$3\frac{1}{4}$	$1\frac{1}{2}$	67	1280	270 — 450
42	8	$\frac{1}{4}$	$\frac{1}{4}$	4	2	77	1400	300 — 500
42	10	$\frac{1}{4}$	$\frac{1}{4}$	5	2	96	1650	500 — 700
44	8	$\frac{1}{4}$	$\frac{1}{4}$	5	2	85	1480	400 — 600
44	10	$\frac{1}{4}$	$\frac{1}{4}$	5	2	106	1740	600 — 800
48	8	$\frac{1}{4}$	$\frac{1}{4}$	5	2	101	1650	500 — 750
48	10	$\frac{1}{4}$	$\frac{1}{4}$	6	$2\frac{1}{2}$	126	1930	850 — 1100
48	12	$\frac{1}{4}$	$\frac{1}{4}$	6	$2\frac{1}{2}$	150	2210	1100 — 1400
54	10	$\frac{5}{16}$	$\frac{7}{16}$	6	$2\frac{1}{2}$	159	2725	1200 — 1500
54	12	$\frac{5}{16}$	$\frac{7}{16}$	7	$2\frac{1}{2}$	191	3000	1400 — 1800
60	12	$\frac{5}{16}$	$\frac{7}{16}$	7	$2\frac{1}{2}$	236	3520	1600 — 2000
60	14	$\frac{5}{16}$	$\frac{7}{16}$	7	$2\frac{1}{2}$	275	3950	2600 — 3000

* Address: 3038 Diamond St., Philadelphia, Pa.

air. For ordinary pressures from 80 to 125 pounds per square inch, receivers are designed to stand a cold-water test of from 150 to 165 pounds pressure. In receivers of 36-inch diameter and larger a manhole is usually provided in the lower part of the shell. The accompanying table contains a list of standard-size receivers, together with data as to capacity, weight, etc.

* * *

DETERMINING COMPARATIVE VALUES OF LEATHER BELTING

Large buyers of leather belting, particularly purchasing agents of corporations who get estimates for supplies from a number of manufacturers, naturally feel the need of uniform specifications, so that they may have a basis upon which to compare prices. The result has been a great variety of specifications with some of which it is impossible for any belt manufacturer to comply, while others frequently exclude the purchase of some of the best brands of belting.

Old Idea Exploded

The truth is that the old idea that only certain materials for tanning and rules for currying and stuffing leather as well as for fixing certain lengths for pieces could be used, is exploded. It was claimed a few years ago by a large belt concern (not now in business), that a steer hide whether taken

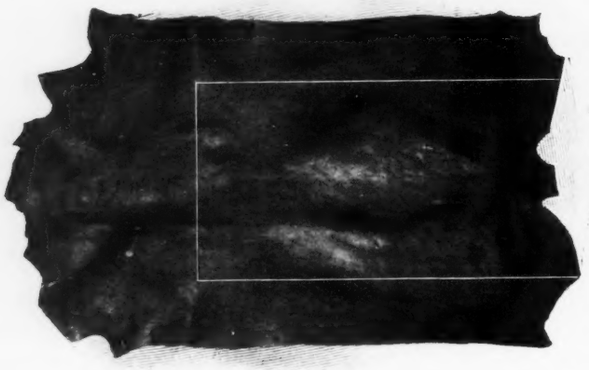


Diagram showing Portion of Hide used in Making Belting

from a small or a large, a young or an old animal would cut pieces of exactly the same length, suitable for belting—no longer, no shorter. But now any man familiar with hides knows that this is absurd. We could as well claim that there is no more cloth in the coat of a giant than in that of a dwarf, as to suppose that the good portion of the hide is of the same size, whether the steer from which it is taken weighs 1000 pounds or 1500 pounds. This being the case, it is evident that to cut the pieces taken from a large hide to the same length as those taken from a medium-sized one must waste good leather in the large hide and consequently increase the cost of production and the price to the buyer. If all hides were of the same size, thickness and consistency throughout, like a plate of steel, it would be a simple matter to make good belts, but they are not; hence no hard and fast rule can be laid down for their construction.

Making a Good Belt—Improvement in Methods of Currying and Tanning

The best leather was at one time supposed to be cut from directly over the back of the animal, but very careful tests have proved that the strongest leather is not there, nor toward the butt end of the hide, but just back of the shoulder and about one-third of the distance from the backbone to the belly.

Again the old ways of currying and tanning have given way to improved scientific methods which were scoffed at and condemned in their infancy as innovations and fakes. Our grandfathers did not know how strong their tanning liquors were; they guessed at the amounts of materials used, applied the greases to the outside of the leather, and got but little into the center fibers. To-day we have our laboratories and appliances, which insure vastly more uniform results than were then obtained. Then "pure oak tanned leather" was considered the only stock from which to make the "best belts," but now there are belts which have never seen "pure oak bark" or any "oak bark" at all, which command highest prices. Thus it is evident that it is not alone a question of rule-of-thumb tannage, of currying, or of the length of pieces, but one of the use of brains—the employment of the best talent and machinery in all the processes of the work combined with the strictest supervision.

What Constitutes a Good Belt

It naturally will be asked what then constitutes a good belt and how the buyer is to compare values without specifications. Replying to the first part of this question and granting that good leather is provided (which by the way may or may not be oak tanned), *uniformity of material is of the first importance.* By the term uniformity we do not mean exact uniformity of thickness, but uniformity of working efficiency; *i. e.*, a belt in which all the pieces rigidly class in the same grade, not one piece of first grade and perhaps the next piece to it of third, as is not infrequently the case. A belt composed of ten pieces of leather may have in it one piece of poor stock which will put the whole belt out of commission. The determination of a belt's working efficiency requires expert knowledge. Mere piping or wrinkling of the grain or hair side of the leather is not necessarily a serious matter, as some hides will pipe comparatively near the backbone while others maintain their solidity almost to the flank.

Probably the next most important thing to the user is a thoroughly stretched belt, one that does not have to be taken up every few days.

How a Buyer Can Determine Cooperative Values of Belts

As to how a buyer can determine comparative values of different makes, this cannot certainly be decided by weight, thickness or length of pieces. "The proof of the pudding is in the eating," and the proof of leather belting is in the result obtained from its use. It does not take an expert to tell which is cheaper, a belt that costs $50 and lasts six years and stretches but little, or one which costs $45, lasts four years and stretches much. To determine what makes of belting to use, keep a record of the service of each belt and it will not take long to determine which is the cheapest. The results obtained will very likely surprise the average belt user.

* * *

RECORD HEAT FOR A SMALL CUPOLA

The following is the record kept of a heat which was taken for a small cupola 36 inches in diameter in the works of E. Leonard & Sons, London, Ontario, Canada. Coke was used as a fuel, and the composition was agricultural scrap, broken small and mixed with 40 per cent pig iron, each pig being broken into four pieces. The blast engine was 9 inches cylinder diameter by 8-inch stroke, working at 120 pounds steam pressure with atmospheric exhaust and making 290 revolutions per minute. The fan was a No. 5 Sturtevant, making about 3500 revolutions per minute. The piston pressure as noted on the water gage was 16 ounces per square inch, but the pressure occasionally dropped to 12 ounces. The pressure was on for 3 hours 35 minutes, and the amount of metal poured was 45,000 pounds. One large casting was made of about 41,000 pounds and the balance of 4000 pounds was made into small castings. The fan belt was shortened about 2 inches each time the cupola was tapped, and 15 pounds of rosin was used on the belt during the heat. C. CARISS

London, Ontario.

* * *

A SOFT SNAP

"Say, Bill, I've got a fine job now in the office of the *Lallapaloosa;* we don't have *your* cast iron rules and regulations. We can go to lunch when we *feel* like it—none of that foolish stuff with our Old Man about staying in till 12 and getting back at 1."

"That's fine, but do you mean to say that anyone can go and come when he feels like it?"

"Sure, Bill. Oh, of course, we have to punch a time clock, but *every one there* has to do that!"

DONKIN'S DIVIDING ENGINE—EARLY MACHINE TOOLS*

By W. S. DAVENPORT†

There is an old and well-known saying, "The Ancients stole many of our best ideas," and many an inventor after working hard and long on some device which he considered original and valuable, has found to his sorrow that someone else, months, years, or centuries before had conceived the same idea and carried it out with more or less success.

Recently, while on a Transatlantic voyage, our ship received a wireless telegraph message from a disabled sister ship of the same line, and sailed back over her course 150 miles, found the vessel, and towed her safely into port. Naturally our conversation turned to the wonders of wireless telegraphy, when a worthy Scotchman, now a professor in a Canadian university, stated that messages had been sent by electricity from one mountain to another in Scotland without wires a hundred years ago, more or less, but the people believed it to be witchcraft, so the inventor and discoverer was obliged to drop the work. We cannot vouch for the accuracy of this statement, but it illustrates the old adage.

There is, however, an authentic illustration of this saying, which we recently saw, that will be interesting to the readers of MACHINERY, no doubt, and that is a device for correcting the pitch of a lead-screw. It has been thought by most of those acquainted with this device, that it was a comparatively recent invention, but it is not so. In the science department of the South Kensington Museum in London is a very fine machine, constructed in 1826, with the principle carried out in an admirable manner. It is known as Donkin's dividing engine, and is illustrated in Fig. 1 at *A*. The illustration shows the machine fitted to cut an accurate screw, but it was also used for graduating accurate scales, from which the above name was taken. Even at that date, the principle was old, but Mr. Donkin carried it out to a highly perfected state.

The lead-screw of the machine is between the two guides for the carriage, and is revolved by the large gear shown on the right-hand end. The nut, instead of being rigidly attached to the carriage, as is the usual practice, is fitted closely between bosses so there is no looseness longitudinally, but it is free to rotate slightly with the screw or in the opposite direction. It is obvious that if the nut rotates with the screw a fraction of a turn, the carriage will travel less than the lead of the screw, and if the nut is rotated in the opposite direction, the carriage will move a proportionally greater distance than the lead. To make the compensating rotation of the nut just the desired amount to correct the inaccuracies of the original screw, the nut has an arm fifty times as long as the radius of the screw. This long arm has a knob on one side which is held, by a suitable spring, in contact with a series of adjustable blocks half an inch wide, each block having its own adjusting and clamping screws. These blocks can be seen with their screws, below

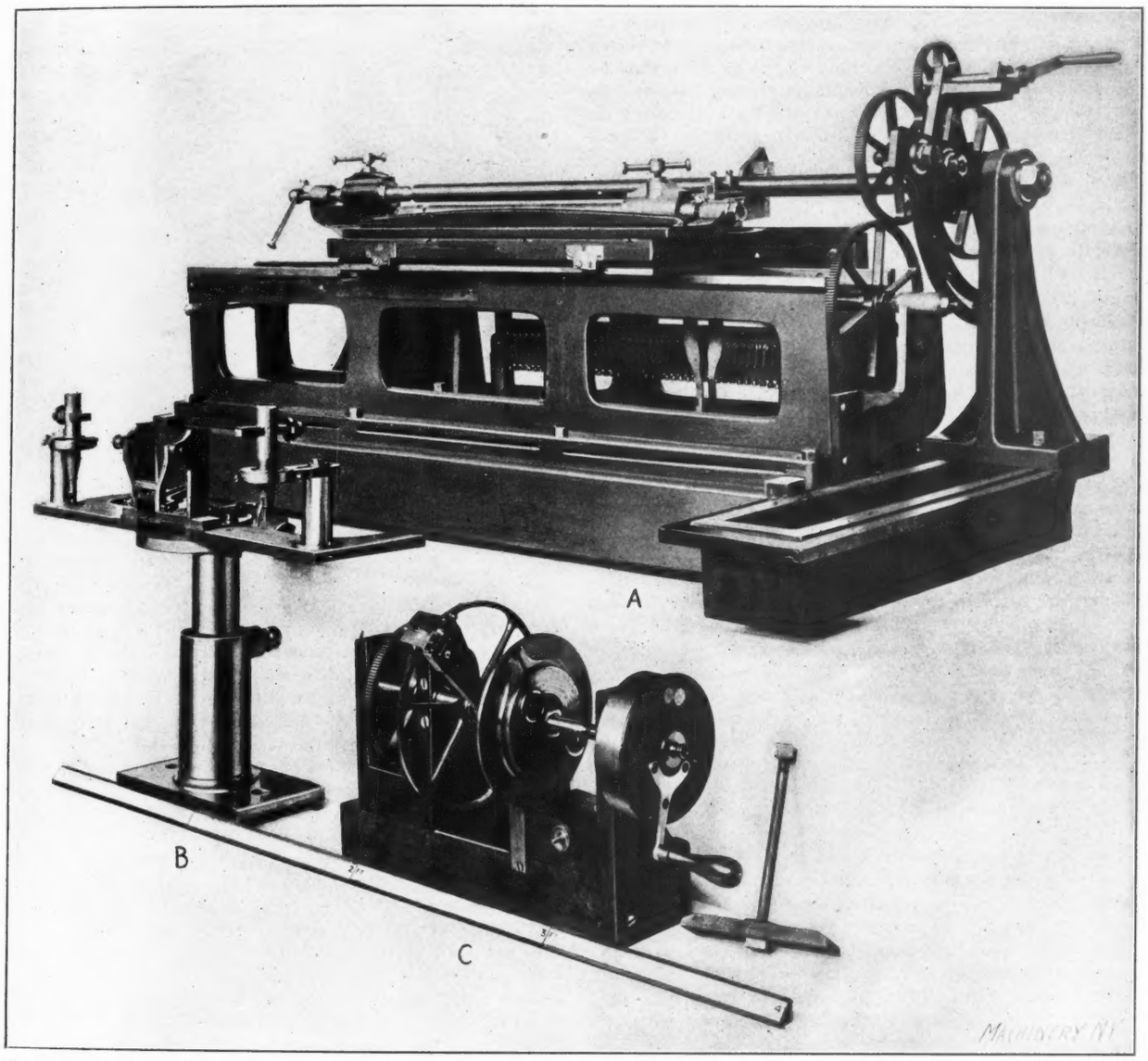


Fig. 1. Donkin's Dividing Engine and Accurate Screw Cutting Lathe. A Compensating Device is provided for Correcting Local Inaccuracies of Lead-screw

* For previous articles published on early machine tools, see MACHINERY, September, 1909: "Chapters in the Early History of Machine Tools," by Joseph Horner, and articles there referred to.

† Address: Davenport Machine Tool Co., 90 Sixth St., New Bedford, Mass.

the lead-screw. The lead-screw is 24 inches long, so there are 48 adjustable blocks. After the inaccuracies of the screw were found, the blocks were adjusted up or down as necessary, till the movement was uniform throughout the whole length. The corners of the blocks were rounded off, so the knob would ride easily over them.

At *A* in the illustration Fig. 1 the machine is shown from the back side, as this view best illustrates the principle of the compensating arrangement. The small view *B* shows the graduating device and two microscopes mounted on a table, and all supported by a post in a bracket. This device was placed on the front of the machine, and used in finding the errors of the original screws, testing the lead-screw until it was correct. The testing was accomplished by graduating very fine lines on a polished strip of brass—first 24 inches apart, then bisected, then both these divisions bisected, and so on till there were 24 lines, the microscopes being used to compare the divisions, and finally, after repeated adjustments of the blocks, the nut with the long arm traveling on the blocks moved the carriage uniformly the whole length so graduations could be made perfectly uniform. The second small view *C* shows the ratchet wheel with 500 teeth which was geared to the lead-screw when the machine was used for graduating.

In the illustration, the machine is shown arranged to thread the screw at the top, which is 36 inches long, necessitating two settings of the carriage with relation to the work; the tool carriage is attached to the nut carriage by the clamps on the rod. The lead-screw is of very fine pitch, being 50 threads to the inch. In threading, the screws were both turned by the crank shown at the top of the machine.

So far as known, this was the first accurate dividing engine made, and the first really accurate screws were cut on this machine. The principle, however, was old at that time, as it had been used in a crude way by Maudslay, who made a correction of 1/16 of an inch in 7 feet by an inclined guide for the nut, but did not correct the local inaccuracies.

In the same department is the original Maudslay engine lathe, made late in the eighteenth century, and a notice in the case with it states that this is the first lathe ever made with a self-acting tool carriage and a lead-screw for use in threading other screws. [See illustration of this lathe in MACHINERY, September, 1909, page 1, engineering edition.] Previous to the building of this lathe, slide rests had been used which could turn short lengths only, and screws were cut only with dies or toothed chasers in hand tools, which at best would produce only inaccurate leads. The head- and foot-stocks are attached to only one of the inverted V's, but the carriage slides on both, and has a cross-slide with a graduated collar on its feed-screw. This is an illustration of the original conception's being correct, although not copied on the thousands of lathes built during the greater part of a century. It has been provided, however, on the best class of tools during the last twenty-five years. Provision is made in the tool-post for three tools, but probably not for roughing and finishing tools. Doubtless two were used as supports for slender work, and one for the cutting tool. The shape of the cross-section of the inverted V's has been closely followed in American practice. The dovetailed fit of the cross-slide at the start, seems to have differed but little from our present practice.

It seems that in making screws, Maudslay had tried many devices before he succeeded in making one good enough for this lathe. He first tried to wind a metal wire or tape around a bar, but could not get as even pitch as desired. He then constructed a machine, also exhibited, which he made about the year 1800, in which round bars of hard or soft wood or metal were rotated in a long hole, and a chisel or cutting tool set at an angle and held by a graduated device, cut into the work at an angle and caused the work to travel longitudinally as it was rotated, the lead produced being controlled by the inclination in the cutting tool. [For illustration see MACHINERY, November, 1909, page 189, engineering edition.] The best of these were taken as lead-screws and from one of these the screw was made which is now in the lathe. Think of the struggles these pioneers had to originate the methods and first tools, making our present machines possible.

Near by is a "planing machine" made by Richard Roberts in 1817 and said to be the first machine made for planing metal. [For illustration see MACHINERY, October, 1909, page 91, engineering edition.] It is evident from the marks of chipping chisel and file that this was made without other tools than these. At this early date, the correct principle of grinding a slide was used, one side being a V (long and narrow), and the other a flat surface.

The table has bolt holes for securing the work. The cross-rail is supported by a standard each side of the bed with screws for adjusting for height, and has a screw for feeding

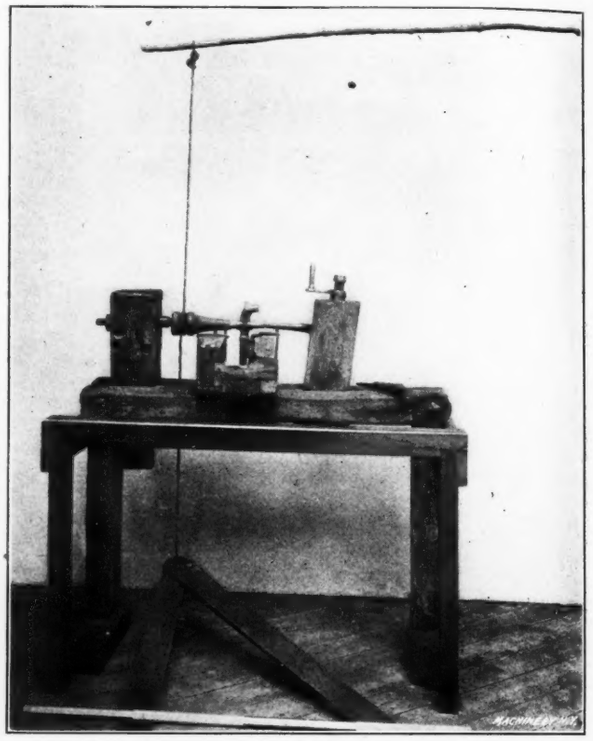


Fig. 2. Pole Lathe in South Kensington Museum, the Oldest Form of Lathe Known. This Lathe was in Active Use until about 35 years ago

the tool across the work. The tool is held in a hinged clapper arranged to lift on the return stroke, and a screw is provided for feeding the tool down to the work, which also can be adjusted to feed at an angle. With the exception of the traversing of the table, which is done by hand and chain, and the absence of automatic feed, the metal planer seems to have come into existence in a remarkably perfect form.*

Going still further back, Fig. 2 illustrates a "pole lathe" which is the earliest form of lathe made. This particular lathe was made in about 1800 by Thos. Nokes & Sons, and was in use as late as 1879 by them for turning parts of stop-cocks, etc. The work does not revolve continuously in one direction, but oscillates in each direction perhaps a dozen revolutions each way. The strap connected with the treadle is wrapped around the wooden arbor of the lathe and leads up to the spring pole. As the operator pushes the treadle down with his foot, the work rotates forward and the cutting is done; the hand tool is then drawn away from the work and the spring pole draws the treadle up again, the spindle, of course, rotating backwards. This seems very slow and crude, but is in daily use in many small shops on the shores of Lake Como, where fancy novelties are made of olive wood to sell to the many tourists who flock there every year.

Compare this very crude lathe of 1800 and the beautifully wrought Donkin's dividing engine, and it is obvious that great strides were made in the early part of the last century, and that the improvements made then were even more marvelous, relatively, than those of which we are wont to boast of at present. Maudslay, Donkin and others had the field all to themselves, it is true, but they were men of great minds and made great improvements, laying the foundation for our present progress and prosperity.

* Comparatively little is known of the early development of metal planers and of the various schemes tried for producing planed surfaces beyond that many inventors worked on the problem with indifferent success. Most of them worked secretly and what they individually accomplished is for the most part unknown. See "Industrial Biography," by Samuel Smiles.—EDITOR.

NEW FACTORY OF THE FRANK MOSSBERG CO.

By CHESTER L. LUCAS*

The location of the Frank Mossberg Co.'s new factory at Attleboro, Mass., is ideal. Directly on the main line of the New York, New Haven & Hartford Railroad and but a short distance from the station at Attleboro, the two-story brick factory is situated on high, level ground. Apart from the factory district proper, the light and surroundings of the building are superior and the view of green fields from its windows is a refreshing change from the outlook upon the cinder yards and busy streets that the average factory windows afford.

The building itself faces the east. This position was necessary on account of the north and south direction of the railroad. It being impracticable to employ the usual type of mill construction with saw-tooth roof, a roof with the saw-teeth placed lengthwise of the building was used so as to supply the best light.

At the front end of the building and on the second floor are the business offices, the private offices for the officials of the company and the drafting-room. These various offices are finished in Flemish oak and are of ample size for the purposes intended. Fig. 2 shows the general appearance of one of the offices.

On the south side of the second floor is the toolroom. Here the dies and tools for the factory work are turned out. The punch and die shown in Fig. 4 are fair specimens of the tool work. The remainder of the floor is given up to light machine work, screw machines, shapers and lathes, milling machines and the like. At one part of this floor is maintained an apprentice department where the boys are started at their trade. By keeping the younger apprentices on these machines until they are accustomed to the proper use of machine tools, the machines in the toolroom are saved much abuse. The view of the screw machine department, Fig. 3, illustrates the well-lighted condition of the rooms, and throughout the factory the same good lighting is noticeable.

Fig. 1. Factory of the Frank Mossberg Co., Attleboro, Mass.

The polishing and plating departments and also the hardening department are located in the building at the right of the main factory as it appears in Fig. 1. The plating room is shown in Fig. 5. The arrangement of the tanks and various baths is most convenient. The wiring of the work is all done at the corner of the room where the work enters from the factory. At the center of the room are the various dips, potash and hot water tanks and the cleaning benches. On both sides of the room are the nickel solutions, easy of access from the central row of cleaning tanks and dips.

The current for the plating tanks is furnished by two direct-connected dynamos, one of 1500 ampere capacity and one of 500 ampere capacity. In order to avoid the expense that would be necessary for wiring the smaller work, a rotary plater has been installed that effectually cares for this item. Instead of the usual boxes of sawdust for drying the parts, this company places the plated work in a large basket and forces a strong current of hot air through them, a method that is both quicker and cleaner. The cleaning of much of the work is done in a tank with a special solution. The process employed is just the reverse of the nickel plating operations, for the current passes through the solution in the opposite direction from the one taken while plating, and this process removes the grease and dirt rapidly.

The polishing department, in which from 50 to 75 men are employed is kept exceptionally clean by means of a powerful exhaust fan driven by a direct-connected electric motor. Friction is eliminated as far as possible by the use of ball bearings mounted on the main shaft, and each shaft length is driven by an independent motor. A great deal of the brass goods manufactured receives a high polish and consequently must be lacquered to protect the finish. Instead of applying the lacquer with a brush or dipping the articles in the lacquer, a spraying process is used. Compressed air is forced through the lacquer tank and by means of a nozzle

Fig. 2. Interior of one of the Offices

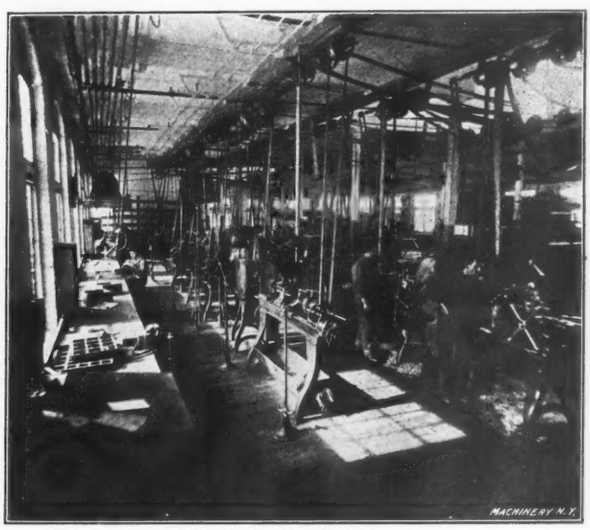


Fig. 3. Screw Machine Department

* Address: 4 Bailey Ave., East Saugus, Mass.

from this tank the lacquer is sprayed onto the work, a better result being obtained in this way than by dipping—the process is also quicker than brushing.

The hardening room is well equipped with furnaces, most of which are operated by crude oil. The problem of storing the oil supply has been taken care of by means of a large

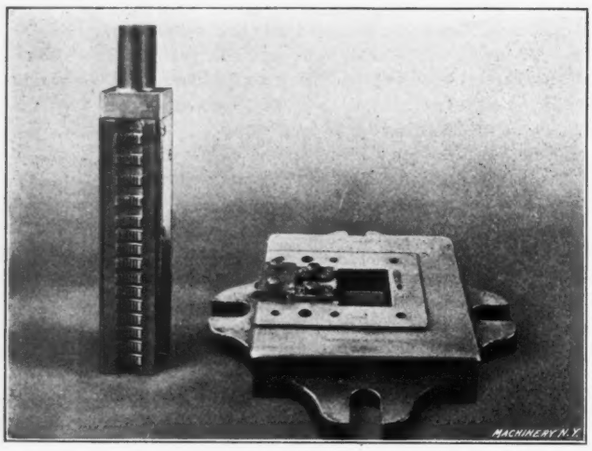


Fig. 4. Broaching Tools for Gear Teeth

underground oil tank that is placed under the car tracks outside of the building so that the oil cars may be quickly emptied; at the same time the oil is not exposed to fire risks. As required, the oil is pumped into the factory and fed to the furnaces. The hardening furnaces are equipped with recording pyrometers that enable the hardeners to put the work through at the proper heat and, of course, the results are uniform. In addition to the crude oil burning system used for the larger furnaces, a gas plant is installed for making gas from gasoline. This gas is made with the proper proportion of air and is piped to the different departments where it is to be used.

At the rear of the building, on the second floor, are the inspecting, packing and shipping departments. The wrenches,

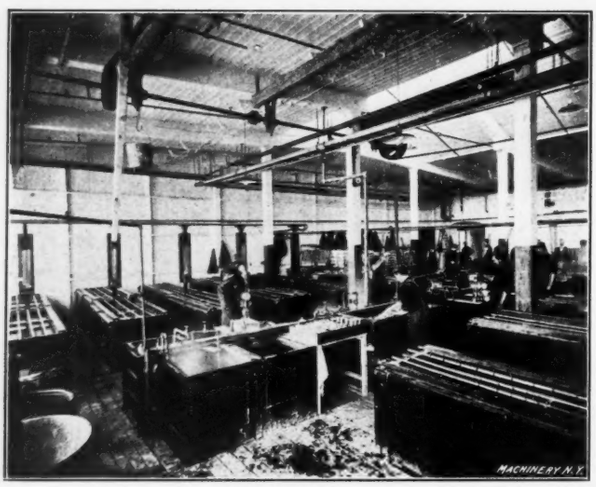


Fig. 5. Nickel Plating Department

bells and other specialties pass through these departments successively to their final destination on the freight cars in the yard.

The lower floor of the factory is given over entirely to punch-press work. Fig. 6 shows a section of the department that is used for heavy press work. The press shown in the illustration is powerfully geared and the heavy frame is supplemented by four three-inch steel rods that strengthen it beyond danger of breaking. The press is motor-driven and is shown set up for piercing the sides of large wire reels. These reels are made in a large variety of sizes, from 2 to 72 inches diameter, and are for holding wire of all kinds as sent out by the wire manufacturers. A group of these spools may be seen in Fig. 7, the large spool being made of iron and the smaller ones of brass.

Wrenches, both adjustable and socket, form a considerable part of the firm's output. The group shown in Fig. 8 illustrates a few of the 75 styles and sizes of the adjustable wrenches and most of the styles of socket wrenches. At the center is shown a socket wrench complete, applied to a pipe joint. Mounted on the board shown in Fig. 9, is a set of shells that illustrates the evolution of a socket wrench from the round blank to the finished wrench. After blanking, the piece receives eight draws, each drawing the shell a little deeper and narrower. After the eighth draw, the process is divided into two groups, one for the wrench for hexagon, and one for the wrench for square-head nuts. From this dividing point, in the case of either style of wrench, the first two or three operations are to draw out the narrow part of the shell and the final two operations are the shaping of the hexagon and square sections. These latter operations are done in the drop press by placing within the shell a mandrel of the correct shape and then striking the shell sideways between dies that give it the finished shape. The other pieces in this illustration are specimens of the drawn work done in the Mossberg factory.

The adjustable wrenches for bicycle, automobile and gen-

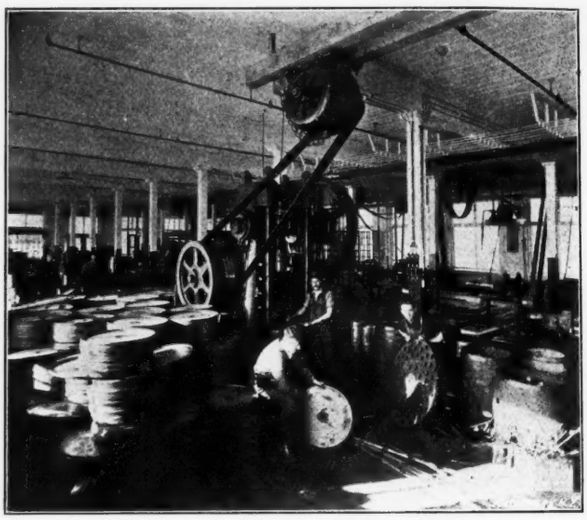


Fig. 6. Heavy Press Work Department

eral use are made in larger quantities than the socket wrenches and consequently there are more interesting operations employed in their making. One of these operations is the broaching of the wrench teeth, which is done in a punch press as shown in Fig. 12. As the position of the press did not admit of taking a detail photograph, a set of broaching

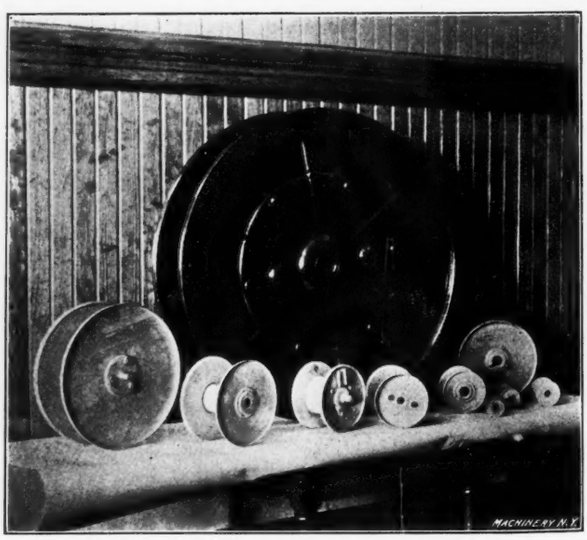


Fig. 7. Wire Spools and other Drawn Work

tools was photographed showing the construction of the punch and die, which, although not for wrench work, illustrates the principle of the broaching dies. In this illustra-

tion, Fig. 4, the die consists, primarily, of four pieces set into a cast-iron bolster. The pieces at the top, bottom and

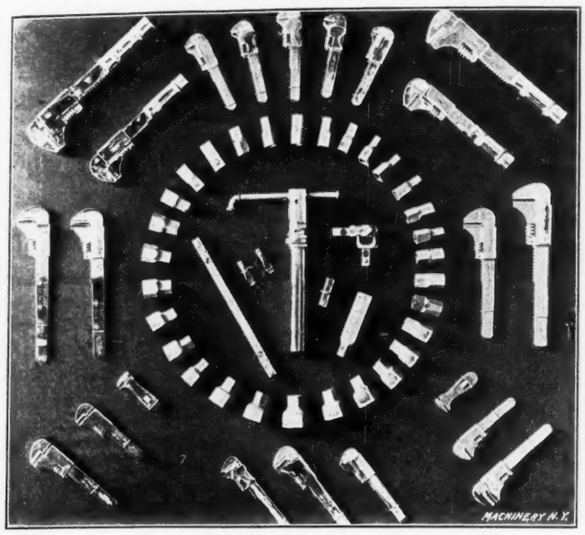


Fig. 8. Various Styles of Socket and Adjustable Wrenches

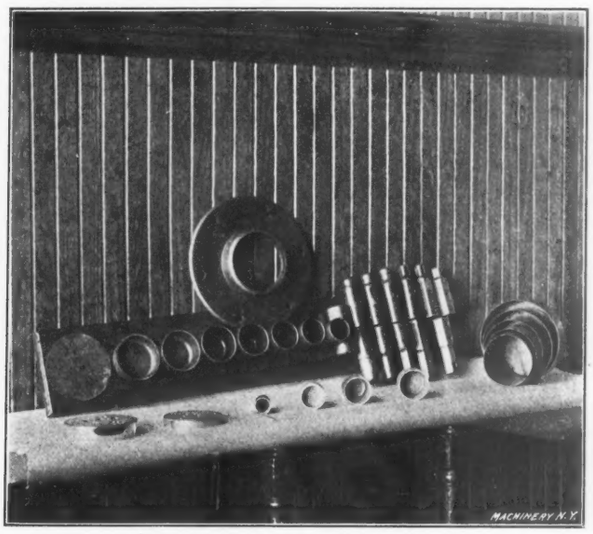


Fig. 9. Evolution of a Socket Wrench

right-hand side of the rectangular opening, are of machine steel, casehardened 1/16 inch deep, and the left-hand section

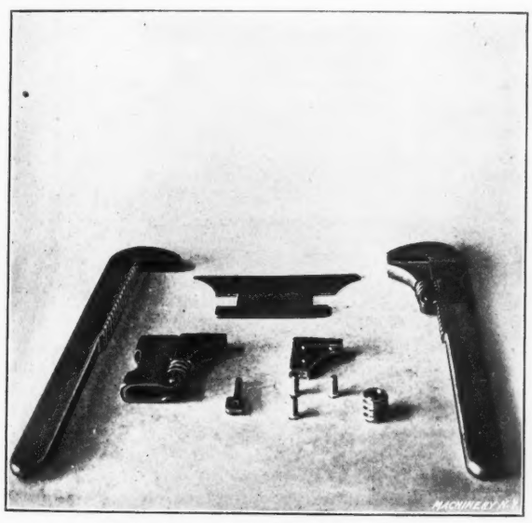


Fig. 10. Component Parts of a Wrench

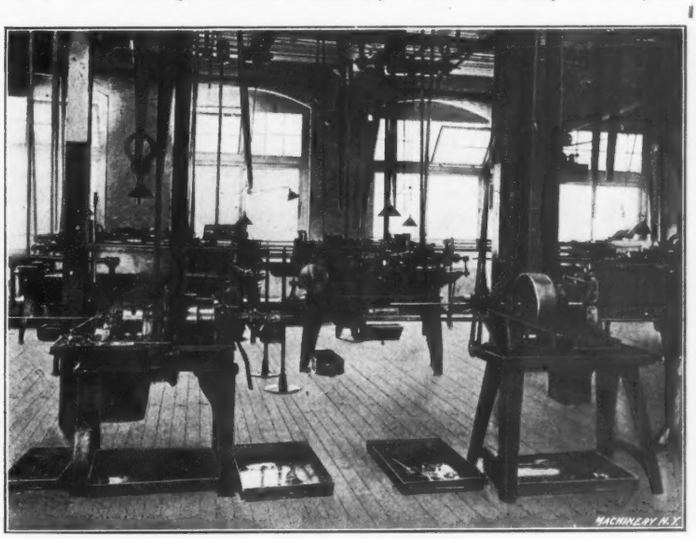


Fig. 11. Threading the Stock for Wrench Nuts

is of high-speed steel and is the broaching die proper. These four pieces are each a driving fit in the bolster and are dow-

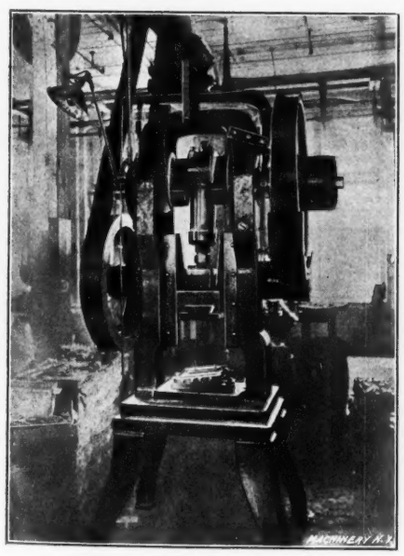


Fig. 12. Broaching Wrench Teeth

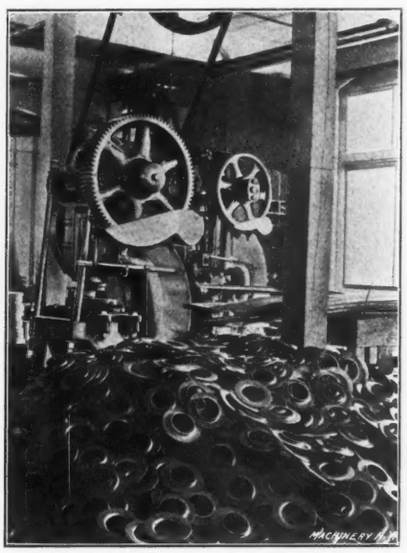


Fig. 13. Making Automobile Hub Flanges

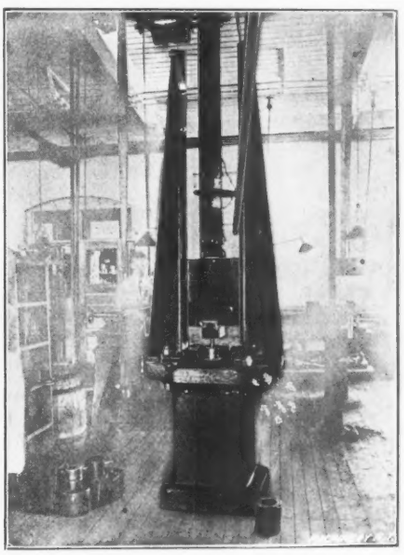


Fig. 14. Novel Drop Press Foundation

eled and screwed in place. On the top of the die section are screwed the hardened locating gages that confine the blank

while being broached. The broaching punch is built up of casehardened machine steel sides. The side that does the actual broaching is of high-speed steel and consists of a number of steps as in the ordinary broach. As may be seen, the steps at the bottom do but little cutting and hence are closely spaced. Each successive step removes a little more of the stock, except the last three or four steps, which do little more than to smooth the surface and size the teeth. As the sides

of the punch fit the opening in the die closely, the broaching teeth are kept perfectly aligned and there can be no springing away of the punch. By the use of this type of die, all the advantages of the sub-press are gained at about one-third the cost. The Mossberg people have made a special study of broaching problems and some of the work done on wrenches, typewriter, clock and adding machine parts, is indeed creditable. The inclining of the broaching die in Fig. 12 is, of course, to give the proper pitch to the wrench teeth and incidentally enables the broaching to be more easily done.

Electric lighting for presses and other tools where the light must be at close quarters, is taken care of by fixtures like that at the left of the press in the illustration. The general lighting of the shop is by tungsten lamps of the 250-ampere size. These lights with shades are suspended from the ceiling by means of spring fixtures.

After the teeth are broached, the company's name, the size and trade name of the wrench, are stamped upon the shank. As this is a simple punch-press job, no further description is necessary. The stamping operation completes this part of the wrench and it is now ready for the polishing and plating department. The sliding jaw is first punched out as a flat

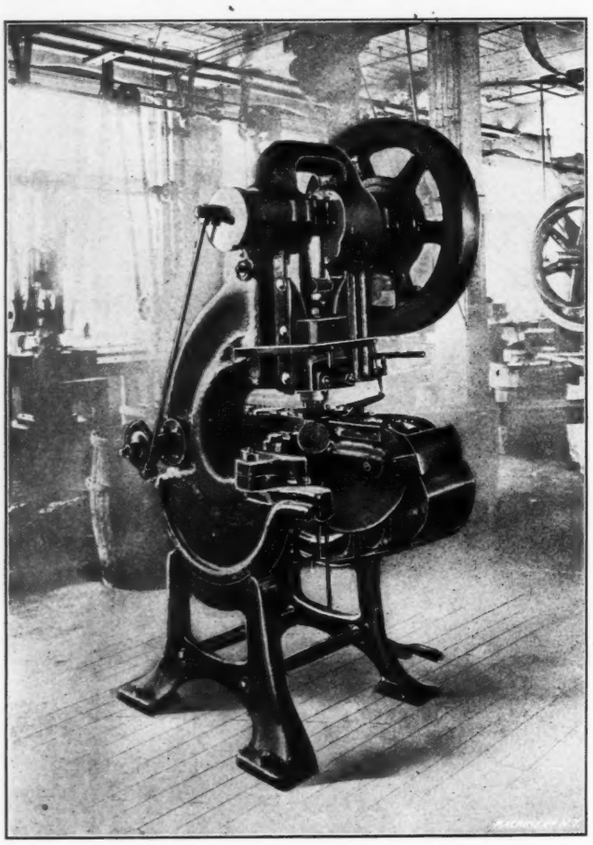


Fig. 15. Endless Belt Feed for Press Work

punching and then bent to shape. Fig. 10 shows this and the other parts that compose the wrench.

Making the wrench nuts is an interesting series of operations. Fig. 11 shows the machines used in the nut department. The two machines in the foreground thread the stock automatically. All they require is the putting in of fresh bars, after which they literally eat it up at the rate of about two feet a minute, the speed varying with the size of the stock. A feature of the machine is the construction of the feed rolls that advance the bars. These rolls are grooved *lengthwise* so the bars cannot turn laterally and spoil the thread or break the die. After the bars leave the threading machines they are taken to the Acme automatics and knurled and the center hole drilled. Each of the Acmes turns out 4000 pieces per day when on a run of the wrench nuts.

Drilling the solid part of the sliding jaws and the pin upon which the nut turns come next, and then the assembling. The latter operation is done upon riveting machines and the sliding jaw is then ready for grinding, polishing and plating. While the polishing and grinding department is a large one, there is little of mechanical interest there. Casehardening in the big oil furnaces imparts a beautiful dark blue color to the steel as well as hardening it to a depth sufficient to withstand ordinary wear. Those wrenches that are to be highly finished go to the polishing and plating department for a coat of nickel. Each wrench is then inspected, wrapped and sent to the stock room as one of the 75 varieties.

While wrenches are the standard production of this factory,

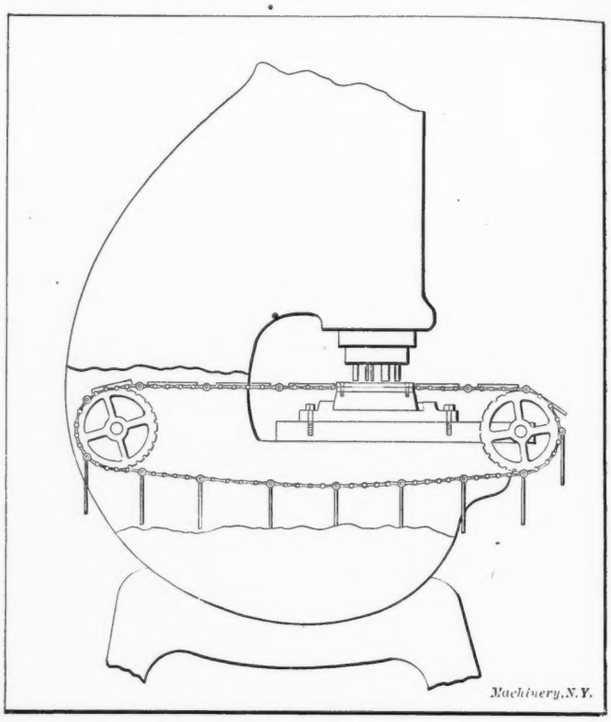


Fig. 16. Details of Endless Belt Feed

there are other branches of work done that are of more than passing interest. Fig. 13 is a striking view of the press-working of heavy steel which is being made into automobile wheel hub flanges. The material is ½ inch thick and the punching is 8¾ inches diameter with a 3-inch hole, the stock being drawn to a depth of ½ inch at the center. The press tools consist of a compound blanking and drawing die. The die works successfully and the pile of punchings at the right of the press in Fig. 12 backs up this statement.

That blessing in disguise, the "tattoo" alarm clock, furnishes a good deal of press work for this factory in the making of the gongs. The press work itself is comparatively simple, consisting of compound dies for blanking and drawing, and dies for piercing the holes and stamping the lettering, but the endless-belt style of feed on the piercing and stamping operation is interesting. At the front and rear of the press are two pairs of sprocket wheels connected by chains. Be-

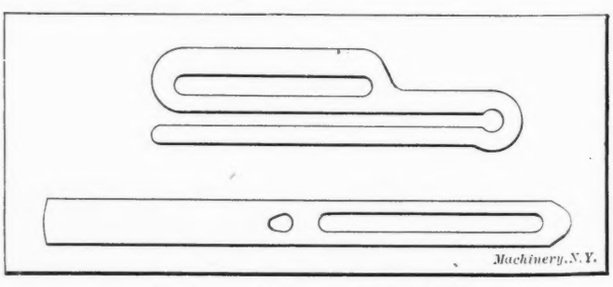


Fig. 17. Punching used in Textile Work

tween these two chains are hinged at intervals, thin steel plates, each with a circular opening, large enough to admit one of the gongs to be pierced. At the front of the press the operator places the blanks in the openings as they rise with the chain, and after feeding under the die they drop out of the openings of their own weight when the hinged plates "flop" over by gravity at the rear of the press. In the photograph, Fig. 15, some of the hinged plates may be seen under the press as they are on their way up to the dies. On the

press bed is one of the blanks showing the pierced holes. Fig. 16 shows this style of feed in detail, and it should be applicable to many other press jobs. The endless chain is operated by a crank on the driving shaft of the press, as shown in the illustration Fig. 15.

It was necessary to locate a 200-pound drop-press on the second floor of the factory and just how to mount it in the best way was a puzzling question. At length a piece of 8-inch iron pipe was set up from the ground to the level of the sec-

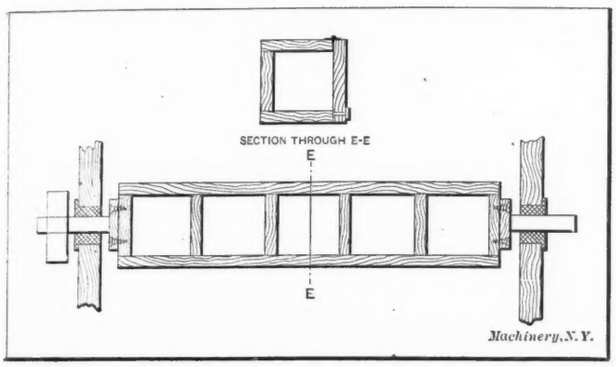


Fig. 18. Arrangement of Tumbling Boxes

ond floor. A cement foundation was put in and the pipe itself filled with cement. At the top of the column a casting was fitted, whose top face spread out to fit the base of the press. The press was bolted to this head and it has proved to be an excellent foundation. The press and base casting are shown in Fig. 14.

Fig. 17 shows two thin sheet-metal blanks that are used in large numbers in the textile industry. They are made of both brass and steel, 0.010 inch thick, and it is very necessary that they be straight and free from sharp edges. Difficulty was experienced in getting rid of the sharp edges because ordinary tumbling methods could not be used on account of bending the blanks. To overcome this difficulty a series of tumbling boxes (Fig. 18) was devised that made the operation quick and successful. These boxes are four inches square and four feet long and are divided into partitions just long enough to take a handful of the punchings when

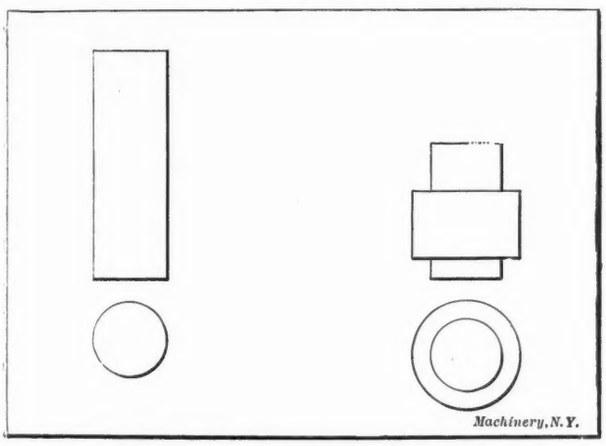


Fig. 19. A Header Job Done in a Punch Press

they are all laid the same way. The boxes are not deep enough to allow the pieces to get tangled up and, in fact, they can only roll over and over. About thirty of these boxes were set up and belted together and enclosed in a little room, and the tumbling of these textile pieces was well taken care of.

A somewhat unusual piece of press work is illustrated in Fig. 19 and while it is really a job for a header it was accomplished in good shape in a heavy press similar to that shown in Fig. 6. One view in Fig. 19 shows the blank, which is soft steel ½ inch diameter and 1 9/16 inch long, before upsetting. The other view shows the piece after upsetting; the length has been shortened to 1 inch and a ring thrown out ¾ inch in diameter and ⅜ inch wide. Needless to say, the dies are made of high-speed steel. They last for about 10,000 pieces before giving out.

Fig. 20 shows the interior of one of the many wash-rooms which are at different locations throughout the factory, and they are equipped with wash-bowls of a new and sanitary design. The bowls are of iron with porcelain facing and each is entirely separate from the others in the line. They are supported by two pins cast integral with the bowl and can be lifted from the rack and cleaned easily. By the use of this system, each man is assured of a clean bowl of water for washing up without having to race for the wash-room at the sound of the closing whistle.

Aside from such conveniences as the wash-room just described, the Mossberg Co. does many things to make its factory conditions congenial to the men and by so doing it is able to get skilled employes and to keep them. No effort is spared to insure the most harmonious feeling throughout the different departments. During the winter months the company maintains a lunch room where food is supplied at cost to those who do not go home to dinner or bring their lunch. They have a base-ball team, and a mutual benefit association; the foremen have meetings each month to talk over the shop work and have a social hour together, and each

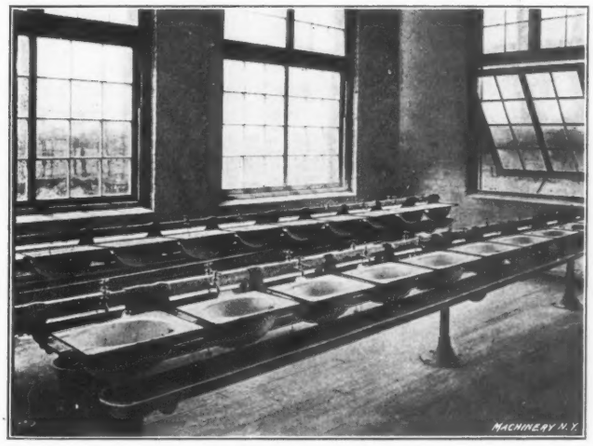


Fig. 20. One of the Wash-rooms

year the shop outing is an attractive feature that includes them all, from the management down to the sweeper.

The officers of the company are: Frank Mossberg, president and general manager; Silas Tuttle, vice-president; Walter I. Tuttle, secretary and treasurer; E. L. Ford, superintendent, and Conrad Luttropp, mechanical engineer.

* * *

PERSISTENCY NECESSARY FOR SUCCESS

"The best laid plans of mice and men gang aft agley" is true of the affairs of the great as well as of the mean and obscure as the proverb really means. It is a common idea entertained no doubt by many of our readers that successful men meet few disappointments—that practically everything they "back" wins, but the truth is they meet many reverses that the world never hears of. The faculty that makes many if not most men successful is the try-try-again spirit. Genius has been defined as unlimited capacity for hard work, and it is largely so.

We recently heard a mechanical engineer of international fame say, when congratulated on the rosy prospects of his latest invention: "You never can tell; I've been disappointed so many times with things that worked out well on paper but which turned out rank failures when put to practical test that I never feel sure of success until it *is* sure."

* * *

The best gas engines, says Prof. Franklin in an article on the second law of thermodynamics, convert about 30 per cent of the heat of the fuel into mechanical work. The best steam engines convert about 10 or 12 per cent of the heat of the fuel into mechanical work. The ordinary run of steam engines, however, convert only 4 or 5 per cent of the heat into work.

HOW A MACHINE SHOP SYSTEM WAS IMPROVED

By M. H. WESTBROOK*

My friend Bob has been a foreman of a machine shop in C——, a neighboring city, for a few years, and the following is part of a letter I received from him about six months ago:

Things are so busy at the shop I must either ask for a few more machines, work longer hours or "go after" my men harder. Now, while I am sure they are just as fast a bunch, if not faster, than the average, and my speeds and feeds up to the limit of the best high-speed steel, I feel that if an entire stranger were to spend a few days in the shop and give me his candid opinion of what he thought should be done to increase the output, he might be able to put me next to things that, through familiarity with them, have passed unnoticed by myself. I wish you would try and come over and spend a week with me. We will have a good time in the evenings trying my new Ford, but in the daytime you get busy in the shop and don't spare my feelings in the least. If you see room for improvement just tell me where. Let me know when to expect you.

Yours as ever,

BOB

Now, as Bob and I used to be shopmates together and as he has done me many a favor, I arranged my affairs and went over to C—— and spent a week in his shop. Following are the conditions as they appeared to me:

Speeds and feeds.—The speeds and feeds, as Bob said, were all that could be desired; his men were above the average in ability and willingness, and his machinery the best and well kept up. At first I thought that conditions were O. K. and that he required more machinery to increase his output, but I was soon able by investigation to find a little slackness here and there.

Belts.—I noticed that when a belt broke the operator of the machine had to repair it himself, wire lacing being kept in the toolroom for the purpose. This resulted in a general run-down condition of the belting throughout. Some very poor lacing was in evidence and much greater time was spent lacing than should have been. A good belt-man can lace a four-inch belt with wire and pliers in four minutes. The average stoppage for belt repair took eleven minutes. I recommended that Bob put on a special belt man whose whole duty would be to repair and keep all the belting in good condition. I also recommended that every noon hour, when machinery was at rest, be spent in examining a certain section of the belting, dressing it where necessary with a good dressing made by a reliable belt manufacturer and not with one of the many forms of belt dope which are supposed only to keep a belt from slipping off the pulley. I recommended that this man be paid sufficient to insure his keeping on the job, and that belt literature be put in his hands occasionally, and that he be frequently questioned about the subject; also that he be fully informed on the value of the material in his charge.

High-speed steel.—While all the machines were using high-speed steel, no high-speed drills were in use. Now my own experience with drills is that for any but cored work we cannot afford to use common twist drills even if supplied free. I advised Bob to procure a Celfor high-speed twist drill for some work of which he had a great deal, and we made a demonstration, with the following results: The common twist drill drilling 1-inch holes in steel plate 1⅜ inch thick, running at 35 feet peripheral speed per minute, feed 0.018 inch per revolution, required grinding about every ten holes. The high-speed drill running at 90 feet per minute, feed 0.025 inch per revolution, drilled 53 holes before requiring grinding. On reducing the feed to 0.018 inch per revolution several hundred holes were drilled without grinding. Bob took special interest in this as the drill work was always behind and he had been sure that he required two new drilling machines up to this point.

Drill work done on lathes.—I also found many jobs being done on lathes with boring bars and threading tools by machinists, at 34 cents an hour, that could be done equally well on drilling machines by the use of special cutters and taps at a much less cost per hour in wages and in some cases in one-half the time. The only change necessary was altering the patterns so that instead of coring the holes out to nearly the proper size in cast iron, the cores were discarded and the castings made solid; by using high-speed drills and counterbores, in addition, the best results were obtained. I have seen this weakness in many places I visit, real good drilling machine jobs being done on lathes and boring mills for no other reason than that the casting had been cored out.

Non-productive periods of machines.—I noticed that when a change of jobs was to be made on the larger machines, boring mills and planers particularly, much time was lost, owing to the machinist doing this work alone, the machine standing idle while many bolts were being removed, cuttings pulled out of the slots and swept away, and work set up and clamped. The work is progressing only when the chips are flying. I advised Bob to hire a few machinists' helpers for just this work, men trained to be "Johnnie on the spot" when machines were to be loaded or unloaded. From personal experience I know this is a paying proposition.

Tool-grinding.—This was being done by the machinists themselves, Bob stating that he did not want to stir up any discontent among them by having, as he termed it, "some dub" do the grinding for good machinists. Now, here is where I expect some readers will say Bob was wrong, that he should have put in a tool grinding system whether the men liked it or not, and that it was Bob who was running the shop, etc. It must be borne in mind, however, that the business was paying well. Bob's employers were not complaining on that score but were pleased with the results. Having surrounded himself with a number of excellent mechanics he could hardly be blamed for not wishing to create any discontent.

Inasmuch as some of Bob's men on special work had their own good ideas regarding the best form of tools to use, I advised that, instead of adopting, all at once, one of the various standard tool grinding systems, he have the patternmaker make wooden samples of each kind of tool that had proved satisfactory, number them, have some of each forged and have the special man for grinding keep them on hand ready for instant exchange when necessary. By doing this gradually he would soon have his system installed and everybody satisfied. This was done and I have since learned that in less than two months the system was extended to cover almost every class of work done with tools; each sample was numbered and a framed blueprint in the grinding department showed just what each tool was for. The men all liked it, in fact a good many took credit for aiding by suggestions as to which form of tool was the best, etc., and for having brought this system into its present condition. Among the men themselves one tool is known as Bill's tool or Jack's tool. This does no harm to the system and lets the men enjoy what honor they can extract from it. Of course, I expect that some reader will criticize and say this is no system at all, but at any rate it was a decided improvement, as the output has shown.

Bad castings.—I found the brass department handicapped owing to the castings having so much coarse sand burned into them that the tools were not standing up as they should. On tracing this up to the source, after much inquiry it transpired that the purchasing department got in a consignment of molding sand entirely unsuitable for the work and not at all what was ordered. The brass foundry foreman rather than make any trouble by refusing to accept it on account of having had the car unloaded before he discovered it, put it into use with the foregoing result. It was found that this car of sand was purchased 20 per cent cheaper than the kind ordered. I find instances similar to this occurring in many establishments to the detriment of the output. I have found also that high-speed steel is not the most suitable for brass work but prefer a good grade of carbon steel having a special temper, as the cutting edge will last longer. Bob took note of this also.

Although Bob was not able to advise me six months later that he had doubled his output, he did write to the effect that after adopting the changes suggested with a few others all of mere detail, he had kept the good will of his men and increased his output nine per cent which was sufficient to take care of the extra work without working overtime, "going after" his men, or putting in new machinery.

* Address: 39 Landerson St., Battle Creek, Mich.

MAKING OPEN-SIDE PLANERS

By ETHAN VIALL*

Owing to the limited demand for open-side planers, that branch of the machine tool industry greatly resembles the manufacture of special machinery. I was informed by the manager of the Cleveland Planer Works, that in their eight years' experience they never had orders on their books for

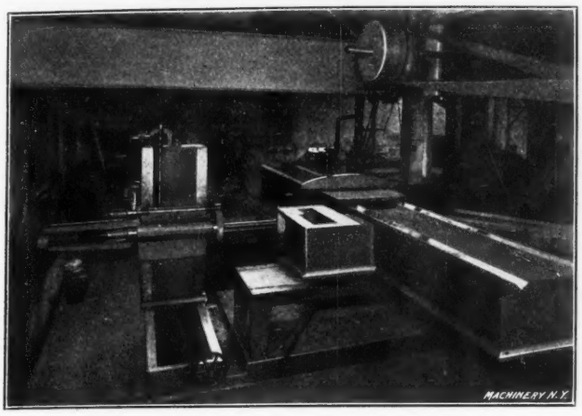


Fig. 1. Large Boring Mill with 8- x 30-foot Open-side Planer Bed in Position

two planers of the same size at one time. It is owing to the varied sizes and character of their machines, that Mr. Dornbirer has been compelled to design and build most of the machinery in use in their shop, in order to profitably handle

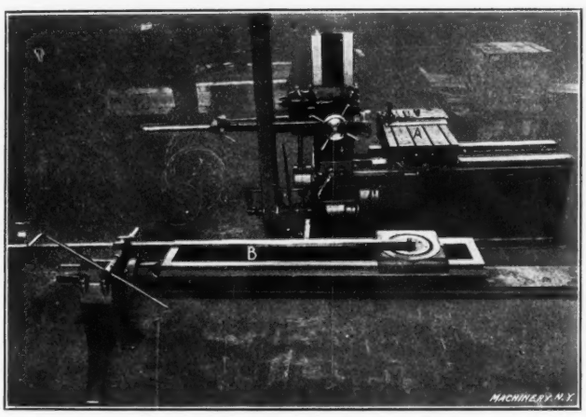


Fig. 3. Cross-rail Scraping Bench with specially designed Boring Mill in Background

their work. For instance, Fig. 1 is a floor boring mill with a very long planer bed placed upon its tables for the purpose of boring out the bearings. An idea of its size can be obtained when it is known that the bed being bored is 8 feet in width at

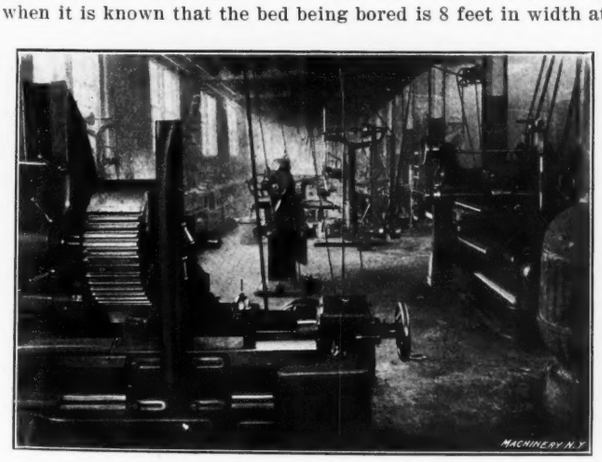


Fig. 5. View of Shop under East Balcony with Walcott & Wood Automatic Rack Cutter at the Right and a Brown & Sharpe Gear Cutter at the Left

the point lying on the table nearest to the front of the photograph, and 14 feet back to the other table. All the beds for their open-side planers are planed on the bottom, which enables the operator to set a bed in position on the boring mill in a remarkably short time.

Some of the simple and efficient details are shown in Fig. 2. The alternating current motor is mounted on brackets fastened to the saddle and is raised or lowered with it. Three speeds are provided by means of cone pulleys. The feeding mechanism is in position for drilling, when the tumbler is in mesh with the center gear on the cone of gears, as shown in Fig. 2.

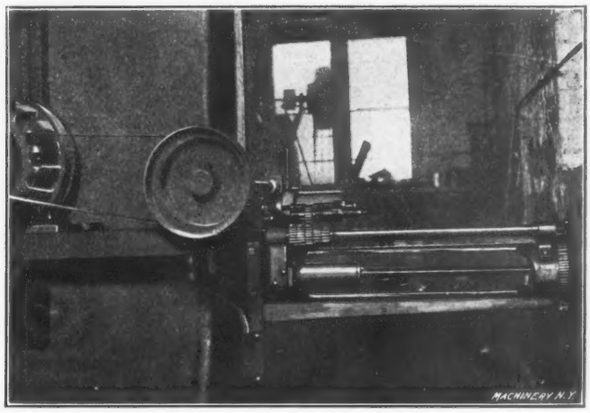


Fig. 2. Geared Bar-feeding Head of Boring Mill

Moving the tumbler to the left of this center gear gives two forward feeds, and moving it to the right gives two backward feeds. In one case the screw that feeds the bar is rotated faster than the spindle, and in the other case, slower.

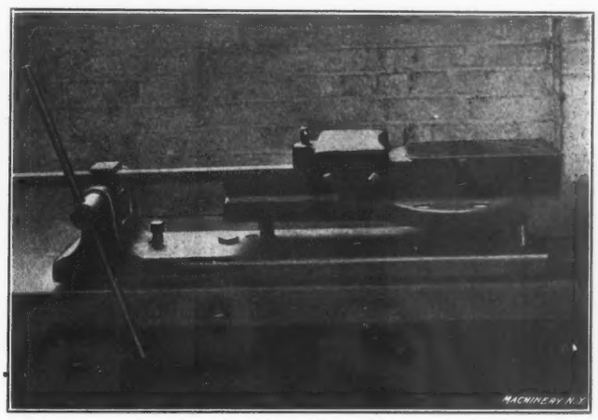


Fig. 4. Bench Scraping Block for Planer Heads

When the screw is locked so as to stand still, a quick return for the bar is obtained in whichever direction the motor is turning.

At *A*, Fig. 3, is shown another boring mill designed by Mr.

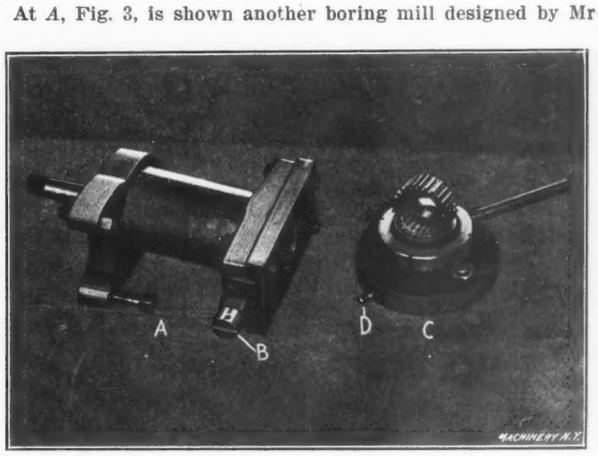


Fig. 6. Milling Machine Attachment for Slotting inside of Ratchet Gears and Chuck for holding them

Dornbirer, but when they built it they embodied so many features to facilitate their work that it will be impossible to go into details in this article. At *B* is a scraping bench that is a marvel of simplicity and convenience, since the cross-rail

*Associate Editor of MACHINERY.

may be placed in any desired position simply by rotating the bench on the trunnions, thus making a hard and tedious job a comparatively easy one. It will be noted that the rack and pinion mechanism is fastened to the bench trunnion so that it always has the same position relative to the top of the scraping bench.

Fig. 4 shows a small scraping bench for the heads, which may be rotated in a plane parallel to the top of the workbench, enabling the fitter to scrape on either side with no heavy lifting or pulling.

Fig. 5 is a view of the shop under the east balcony, showing a Walcott & Wood full automatic rack cutter at the right, and a Brown & Sharpe gear cutter at the left.

At *A*, Fig. 6, is shown a vertical slotting attachment for a milling machine, used for slotting the inside of ratchet feed gears. The cutting tool is shown at *B* and the method of attaching the device to the milling machine spindle is plainly indicated. At *C* is the universal chuck used to hold the ratchet feed gears while slotting them on the inside, the indexing being accomplished by means of the pin *D*, which engages in accurately spaced holes in the base flange of the collet holder.

The saddles are graduated on the machine shown in Fig.

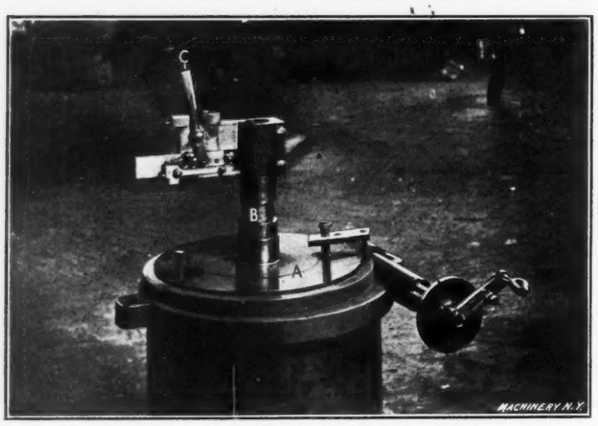


Fig. 7. Indexing Machine for Planer Saddles

7. Under rotating base-plate *A* is a worm gear having a projecting hub *B* over which various sized bushings, to suit the different sized saddles may be placed. The worm gear has 180 teeth and the slack or lost motion between it and the worm, is taken up by rotating an eccentric bushing which forms the bearing for the worm spindle. Two notches are provided in the periphery of the index plate exactly opposite each other so that the handle may be easily moved half a turn, which moves the worm gear plate one degree. The marking head is clamped to the spindle around which the worm gear and its hub rotates. The marking is done by pulling the small hand lever *C* once for each indexing of the saddle, and, by the automatic turning of a small ratchet-cam, a latch is lifted at every fifth stroke of the lever so that the fifth mark is three times as long as the other four.

One of the interesting points to be noticed in this shop, is the unusual use of draw-in collets for all sorts of work. A milling machine with only a twelve-inch index center has been fitted with draw-in collets up to 2 inches, and a set of collets for another machine runs up to 5 inches in diameter by 16 inches in length.

* * *

POSTING REGULATIONS IN SHOPS

In some shops we see a variety of posted rules and regulations forbidding workmen to do this and that under penalty of discharge. In other plants apparently as well organized and disciplined there is a noticeable absence of posted regulations. The question is: Which is the preferable practice? It is our opinion that the posting of rules and regulations is generally resented and that it is best to avoid insulting the intelligence of the workmen by forbidding them to do things common sense tells them they must not do if they expect to retain employment. The most rigid rules governing the affairs of life are largely the unwritten laws. Let the rules of the shop be unwritten but fully understood.

PERTINENT POINTS ON JIG AND FIXTURE DESIGN*

By C. NOSRAC

There are several points of vital importance in the design of jigs and fixtures for the production of interchangeable parts that are often overlooked by the designer, and also in many cases by the toolmaker, yet which, if they had been given the proper attention at the proper time, would have resulted in a marked increase of accuracy and efficiency in the jig. It is practically conceded that the ideal jig should be so designed that it will do a maximum amount of work in the minimum amount of time with the least possible amount of labor on the part of the operator, and with the smallest initial cost. The attainment of any such condition in practice, however, is very rare. Nevertheless, the designer has it in his power to save many dollars for his employers by giving attention to the few most essential points when originating the fixture. A mistake frequently made in the design of jigs for small work is that of making the jig too small. It must be remembered that the vertical alignment of the holes in the jig depends on the accuracy with which the jig rests upon its feet on the drill-press platen, and it must also be remembered that drill-press platens are usually covered with drill chips which get under the feet of the jig, serving to throw it out of the horizontal plane and make it rest unevenly. It follows then that if one leg of the jig is elevated from the platen a fraction of an inch, the drill bushing will stand at a certain angle out of the perpendicular, and also that the larger the base area of the jig is made, the less the angular inaccuracy will become. Furthermore, if the jig is made small and provided, as they often are, with a handle, in order that the operator may have something to take hold of, the chances of inaccuracy of the holes are increased by the possibility of his tilting the jig during its operation by what may even be an unconscious pressure on the handle. Handles on jigs are as a rule unsatisfactory in many cases and they will be found especially so by the operator if the jig to which one of them is attached suddenly "takes charge," and the handle strikes him on wrist or chest.

Material for Jigs

There has been a great deal of discussion among designers, and also among manufacturing firms throughout the country, about the relative merits of cast iron and steel as materials from which to construct the jig and fixture bodies. In the writer's opinion the decision on this point should depend to a great extent upon the usage to which the fixture is to be put and the character of the work which it is to handle. For small and medium sized work, such as typewriter, sewing machine, gun, adding machine, cash register, phonograph and similar parts, the steel jig offers decided advantages, but for larger work such as that encountered in automobile, engine, and machine tool fixtures, the cast iron jig is undoubtedly the cheaper, and more efficient to use. The steel jig should be left soft in order that at any future time additional holes may be added or the existing bushings changed as required. With a cast-iron jig this is a difficult matter, as the frame is usually bossed and "spot finished" at the point where the bushings are located. This, of course, makes it very difficult to build up on the jig frame in order to locate or change the bushings. When designing the jig, these points should be remembered and provision made for them, where possible.

Drill Bushings

The drill bushings should be made of tool steel, hardened and lapped, and where convenient should be ground inside and out. They should also be long enough to support the drill on each side regardless of the fluting, and they should be so located that the lower end of the bushings will stop about the same distance above the work as the diameter of the drill, so that chips will clear the bushings readily. Of course, where holes are drilled on the side of a convex or a concave surface, the end of the bushing must be cut on a bevel and also come a little closer to the part being drilled, to insure

* For information previously published on jig and fixture design, see "Defects in Jig Design," November, 1909, and "Standard Designs of Jigs and Fixtures for the Manufacture of Small Interchangeable Parts," with accompanying references, July, 1909.

the drill having adequate support while starting into the work. The bushings should also have heads of sufficient diameter to prevent the operator starting the point of the drill all around the hole instead of in it, thus mutilating the jig body. Long bushings should be relieved by increasing the hole diameter at the upper end in order to give the drill freedom from its bearing portion. The length of the bearing portion in the bushing should be equal to the length of the lead of the spiral on the drill. The lower end of the bushing should have its edges rounded in order to permit some of the chips being shed from the drill easily, instead of all of them being forced up through the bushing. It is also good practice to cut a groove under the head so that when grinding the bushing on the outside, the wheel will not have to "corner." Correct designs for short and long bushings are shown in Figs. 1 and 2. Clearance holes should be provided below the work. The drill bushings should not be driven

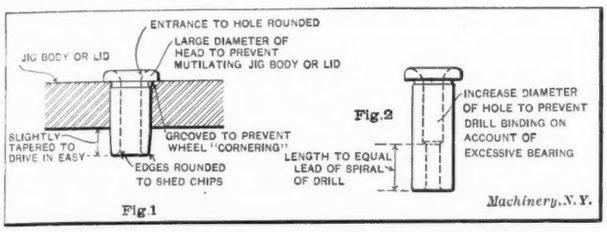

ENTRANCE TO HOLE ROUNDED
LARGE DIAMETER OF HEAD TO PREVENT MUTILATING JIG BODY OR LID
JIG BODY OR LID
SLIGHTLY TAPERED TO DRIVE IN EASY
GROOVED TO PREVENT WHEEL "CORNERING"
EDGES ROUNDED TO SHED CHIPS
Fig.1
Machinery,N.Y.

Fig. 1. Correct Design for Short Bushings

Fig.2
INCREASE DIAMETER OF HOLE TO PREVENT DRILL BINDING ON ACCOUNT OF EXCESSIVE BEARING
LENGTH TO EQUAL LEAD OF SPIRAL OF DRILL

Fig. 2. Correct Design for Long Bushings

through hardened steel blocks as these parts will naturally change to a certain extent during the hardening process and the hole locations will consequently be inaccurate when the bushing is driven through. The length of the bushing should be limited so that special drills will not be required to reach the work when getting into difficult corners. When designing the jig, provision should be made for this by building the fixture closer around the work.

Clamping Devices

When designing the clamping device, as few operating screws or handles should be used as will accomplish the desired result, for it takes considerable time to turn a screw one or two revolutions four or five thousand times a day, which is nearly an average number of operations for many jigs. Making the screw with a double or triple thread is sometimes used to advantage in decreasing the number of turns necessary to release the piece. Jig lids should be hung on taper pins in order that wear in the hinge may be compensated for and the resulting inaccuracy due to the lost motion in the hinge prevented. The included angle of taper on hinge pins should be only one or two degrees and the pins should be spirally grooved to within $\frac{3}{8}$ inch of each end, in order to hold oil for lubricating the hinge after the pin is driven in. The hinge pin should be a tight fit in the central portion of the hinge, which is usually the jig body, and a bearing fit in the ears of the lid. In this manner the greatest wearing surface possible is obtained. (The foregoing points are clearly illustrated in Fig. 3). All clamping screws and similar parts should be long enough and so located as to be conveniently taken hold of to operate, and of sufficient size to prevent hurting the operator's hands on account of the pressure necessary to manipulate them. The screws should be located so that they will resist the tilting action of the block, and the dowel pins should be fairly close to the screws and of liberal dimensions in order to resist the shearing strains to which they will be subjected. When clamping or locating the work in the jig it is essential to have the clamping pressure exerted in a direct line against some solid point of support to prevent the tilting tendency, and the thrust should also come on such a point of the work that it will be resisted by solid metal, as the power of a screw is frequently underestimated by both the designer and the operator of the jig, with the result that the work will frequently be sprung by the clamping device, and drilled in this position, which would naturally spoil the accuracy of the location of the hole after the work was released from the jig and had expanded back to its normal shape. It should be further borne in mind that when clamping rough castings in a fixture they can be supported only on three points, and "tickler studs" or adjustable stops should be placed on the fourth point of the support and also under any weak portions of the piece through which holes are to be drilled or machining operations are to be performed, in order to resist the springing action of the cutter. Posts in which clamping and locating screws operate should be of liberal proportions and should not project above the fixture body any further than is necessary in order to keep down the tilting action to a minimum; and all handles for clamping devices should be so located that they will not be awkward to operate.

Equalizing bars are frequently used to divide the strain of clamping between two points, or to place the pressure upon three points in case it is so needed.

Resting Studs

Resting studs for supporting the work in the jig are usually made of tool steel, and hardened and ground, and should be of such a length that the piece which the jig is to hold will be held up above the jig body far enough to clear the chips which soon accumulate during the drilling operation. In this connection it is advisable to give a generous amount of room around the piece being operated on in order that the jig may be easily cleaned, and that there may be plenty of room for the chips to fall out. Resting studs should also be provided under all points where drill pressure or reamer pressure will come and also under other points where it is necessary to absorb the strains. Jigs and fixtures should also be made to stand as low as possible above the machine platen as the higher up they stand, the more angular error will occur when drilling long holes as chips get under the rest and feet.

It is also customary to equip jigs with suitable lid stops of such a shape and so located that they will not interfere with the manipulation of the various functional parts of the

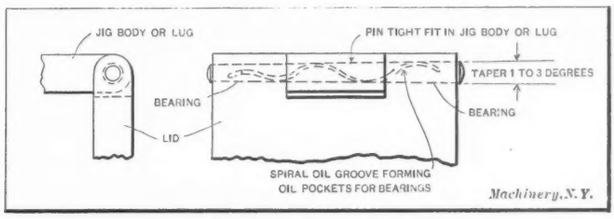


Fig. 3. Improved Hinge-pin Construction

jig. It is usually unnecessary to swing the jig lid entirely back. Therefore, the lid stop may be so placed as to support it after it is swung past the perpendicular, thus saving the extra time required to reach back the extreme distance for the lid every time the jig is closed.

Locating Blocks

Locating blocks and similar parts should be of very solid construction and especially where pressure due to the action of the clamping device will exist, and should be fastened with heavy screws and large dowel pins. It seems queer that designers will persistently screw a locating block onto a jig, with medium size screws or often with large screws, and yet locate the block with ridiculously small dowel pins, entirely losing sight of the fact that the screws do not take the side thrust, nor hold the block in its true location, and that the greater part of the strain actually comes on the pins, with the result that they are either partly or wholly sheared off, and a great deal of work is frequently spoiled before this condition is discovered. When selecting proper locating points on a piece of work, choose the most important one, which must be determined by careful examination of the piece, and consideration of how it is to be assembled in the machine. This locating point should be used throughout the succeeding jigs and fixtures.

If proper attention is given to the above points on jig and fixture design it will undoubtedly result in increased production and greater efficiency of operation.

* * *

The fans of the hot blast heating system in the H. H. Franklin Mfg. Co.'s plant, Syracuse, N. Y., are kept running in summer to circulate fresh air throughout the factory.

DESIGNING SCREW MACHINE TOOLS AND CAMS*

PRACTICE FOR THE BROWN & SHARPE AUTOMATIC SCREW MACHINE

By DOUGLAS T. HAMILTON†

The object of the present article is to give the average mechanic and draftsman a clear idea of the methods employed when designing special tools and cams for the Brown & Sharpe automatic screw machine. One of the first things which the writer considers necessary is a thorough understanding of the change-gear mechanism, as on this are based the fundamental principles used in the construction of the tables for

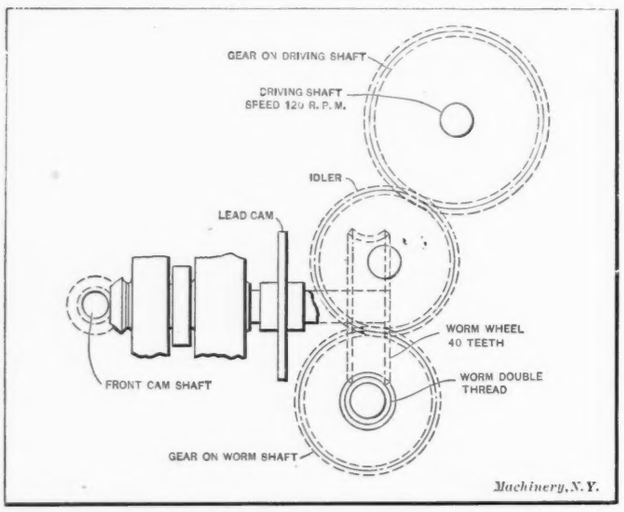


Fig. 1. Diagram of Gearing on the No. 00 Brown & Sharpe Automatic Screw Machine

laying out cams. Following this is the construction of the rise and drop on the cams, this governing the amount of clearance necessary for one tool to pass another. Then a number of general points which should be of value, especially to those who are not experienced in this class of work, are given.

Change-gear Mechanism

A system of simple gearing is used on the No. 00 Brown & Sharpe automatic screw machine, as can be clearly seen in Fig. 1, in which one driving and one driven gear is used. The worm has a double thread, so for every revolution that the worm makes the worm-wheel will travel through a dis-

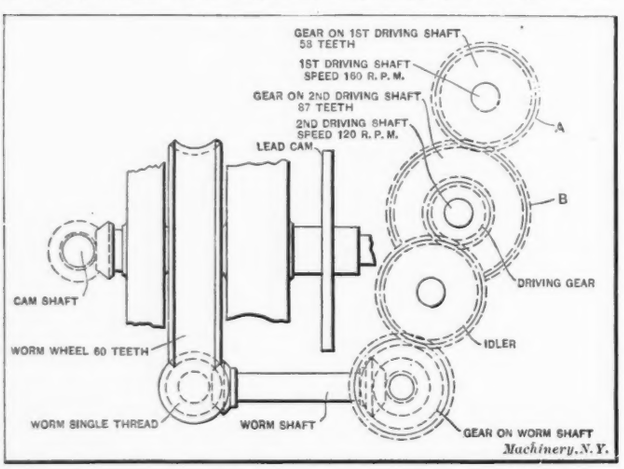


Fig. 2. Diagram of Gearing on the No. 0 Brown & Sharpe Automatic Screw Machine

tance of two teeth. To find the change gears, assume that it is required to make one piece in 12 seconds. This necessitates that the worm-wheel make one revolution in 12 seconds. As there are 40 teeth in the worm-wheel and the worm has a double thread, the worm shaft will make $\frac{40}{2}$ or 20 revolutions in 12 seconds. The driving shaft runs constantly at 120 R. P. M. or 2 revolutions per second. Then the driving shaft will make 12×2 or 24 revolutions in 12 seconds. Considering, in this case, that the driving shaft is required to run the faster, we will put the gear with the larger number of teeth on the worm shaft. Now if we have gears having 20 and 24 teeth respectively they will "do the trick," but after referring to the gears as supplied with the machine, we find that a gear with 24 teeth is not available, so multiplying each by two (which does not change their value) the gears will be: 40 gear on driving shaft; 48 gear on worm shaft.

On the No. 0 Brown & Sharpe automatic screw machine there is also one driving and one driven gear, but on this machine the gear which is called the driver is placed on the second driving shaft as shown in Fig. 2. Then, before finding the change gears it is necessary to find the speed of the gear on this second driving shaft. The first driving shaft runs constantly at a speed of 180 R. P. M. Then the speed of the second driving shaft $= \frac{180 \times 58}{87} = 120$ R. P. M. To find the change gears, assume that it is required to make one piece in 36 seconds. (To obviate confusion, we will call the second driving shaft the main driving shaft which runs at 120 R. P. M.). Since the cam shaft is to make one revolution in 36 seconds and as there are 60 teeth in the worm-wheel and the worm has a single thread, the worm shaft will make 60 revolutions in 36 seconds. The driving shaft which runs at 120

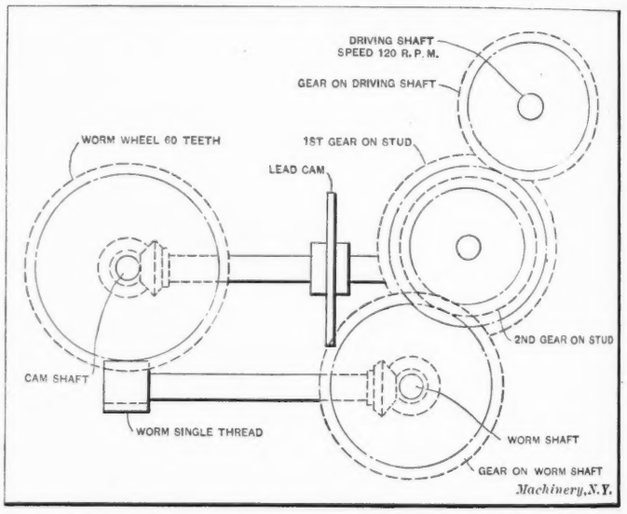


Fig. 3. Diagram of Gearing on the No. 2 Brown and Sharpe Automatic Screw Machine

R. P. M. or 2 revolutions per second will make 72 revolutions in 36 seconds. Now as the worm shaft is required to run the faster, we will put the larger gear on the driving shaft. Then the gears can be found by the following formula:

$$\frac{120 \times D}{W} = \frac{3600}{S}$$

where D = gear on driving shaft, W = gear on worm shaft, and S = time in seconds to make one piece. Then, $\frac{120 \times D}{W} = \frac{3600}{36}$ or $120\ D = 100\ W$. Then $W = \frac{120}{100} = 1.2\ D$. Let $D = 30$. Then $W = 30 \times 1.2 = 36$. If the speed of the driving shaft is less than the speed of the worm shaft the result will be just the opposite. For example, let $100\ D = 120\ W$. Then $D = \frac{100}{120} = \frac{10}{12} W$. Let $W = 36$. Then $D = \frac{10}{12} \times 36 = 30$.

A system of compound gearing is used on the No. 2 Brown & Sharpe automatic screw machine making it necessary to

* For additional information on Brown & Sharpe automatic screw machine practice see "Threading Operations," MACHINERY, June and July, 1910, and other articles there referred to.

† Associate Editor of MACHINERY.

find the various gears by factoring. To explain the method of finding the gears we will take a practical example. Let it be required to find the gears to make one piece in 28 seconds. Referring to Fig. 3 we find that the speed of the driving shaft is 120 R. P. M. There are 60 teeth in the worm-wheel and the worm shaft has a single thread. Then we require the cam shaft to make one revolution in 28 seconds. The worm shaft will make 60 revolutions in 28 seconds as the worm has a single thread. The driving shaft makes 2 revolutions per second or 56 revolutions in 28 seconds. It can be seen that

TABLE I. SHOWING HOW TABLE FOR LAYING OUT CAMS IS CONSTRUCTED

TIME IN SECONDS TO MAKE ONE PIECE	GROSS PRODUCT IN (10) HOURS	NET PRODUCT IN (9) HOURS GROSS LESS 10 Per Cent	GEAR ON DRIVING SHAFT	1st GEAR ON STUD	2nd GEAR ON STUD	GEAR ON WORM SHAFT	HUNDREDTHS OF CAM SURFACE TO FEED STOCK	SPINDLE SPEEDS												
								A DIAGRAM OF THE PULLEYS ON THE COUNTER SHAFTS, AND THE POSITION OF THE BELTS TO GIVE THE VARIOUS SPEEDS CAN BE GIVEN IN THIS SPACE												
								MIN. SEC.	120	148	182	225	277	342	421	519	640	789	975	1200
								NUMBER OF REVOLUTIONS TO MAKE ONE PIECE												
10	3600	3200	80	32	72	60	10		20	25	30	37	46	57	70	86	107	131	162	200

the worm shaft is required to run the faster. Therefore the multiple of the two gears which are placed one on the driving shaft and the other, the second gear, on the stud should be greater than the multiple of the two gears one placed on the worm shaft and the other, the first gear, on the stud. It will also be noted that the number of teeth in the gear on the driving shaft should be greater than the number of teeth in the gear on the second stud, and the number of teeth in the gear on the first stud should be less than the number of teeth in the gear on the worm shaft. The ratio equals $\frac{56}{60}$. By dividing the numerator and denominator into factors and multiplying each pair of factors by the same number we find the gears.

$$\frac{10 \times 6}{4 \times 14} = \frac{(10 \times 8) \times (6 \times 6)}{(4 \times 8) \times (14 \times 6)} = \frac{80 \times 36}{32 \times 84}.$$

Then the gears are as follows:

80 gear on driving shaft, 36 second gear on stud, 32 first gear on stud, 84 gear on worm shaft.

How Tables for Laying out Cams are Constructed

Before a table can be constructed, it is necessary to know the range of spindle speeds obtainable and also the speed of

TABLE II. DIMENSIONS FOR LAYING OUT CAM RISE FOR NO. 00 BROWN & SHARPE AUTOMATIC SCREW MACHINE

Number of Seconds to make one Piece	Lead	Front and Back Cams
	D	R
From 3 to 5 seconds	$\frac{9}{16}$	$1\frac{1}{16}$
From 6 to 12 seconds.....	$\frac{9}{16}$	$1\frac{1}{16}$
From 13 to 30 seconds.....	$\frac{9}{16}$	$1\frac{1}{4}$

the driving shaft. Then the number of seconds to make one piece is placed in the first column of the table, and the number of revolutions to complete one piece is placed under the various spindle speeds as shown in Table I. The total number of revolutions to make one piece is found by the following formula: $r = \frac{R \times S}{60}$ where R = revolutions of spindle or (R. P. M.), S = time in seconds to make one piece and r = total number of revolutions to make one piece. The total number of revolutions to complete one piece can also be found by adding together the number of revolutions required for each operation plus the revolutions required for clearance, feeding the stock, and revolving the turret. The seconds to make one piece are found by the following formula:

$$S = \frac{r \times 60}{R}.$$

To feed stock and revolve the turret requires one revolution of the driving shaft, but it is always advisable to add one hundredth for revolving the turret so that it will be securely locked in position before the tools advance on the work. Owing to the large diameter of the roll there should never be less than 3 hundredths for revolving the turret, irrespective of the speed at which the cam shaft is running. To illustrate clearly the method employed in constructing the table, take a practical example. Let it be required to construct a table for laying out cams for a No. 2 Brown & Sharpe automatic screw machine. Let the spindle speeds be as given in column *a* Table I. To show clearly the method, we will take a spindle speed of 182 R. P. M. Assume that it takes 10 seconds to make one piece. The revolutions required to complete one piece $= \frac{182}{10 \times 60} = 30.03$ or approximately 30 revolutions. We will then put 30 revolutions under the spindle speed 182

TABLE III. DIMENSIONS FOR LAYING OUT CAM RISE FOR NO. 0 BROWN & SHARPE AUTOMATIC SCREW MACHINE

Number of Seconds to make one Piece	Lead		Front and Back Cams	
	D	R	D	R
From 5 to 12 seconds....	$1\frac{1}{8}$	$\frac{15}{16}$	$\frac{7}{16}$	$1\frac{1}{2}$
From 13 to 30 seconds....	$1\frac{1}{8}$	$2\frac{3}{16}$	$\frac{7}{16}$	2
From 32 to 60 seconds....	1	$3\frac{1}{4}$	$\frac{13}{16}$	3

as shown in the table. Then to feed stock $= \frac{182 \times 2}{120} = 3.03$ revolutions. As shown in column *b*, the hundredths to feed stock $= \frac{30.03}{3.03} = 9.9$ or approximately 10 hundredths, and as it requires 10 hundredths of the cam shaft to feed stock, by adding one hundredth to this we get 11 hundredths for revolving the turret. The change gears are found by the methods previously described, and are placed in their respective columns in the table.

Constructing the Rise on Cams

The rise on the cam should be such that the tools will gradually slow up as they approach the work. It is not necessary

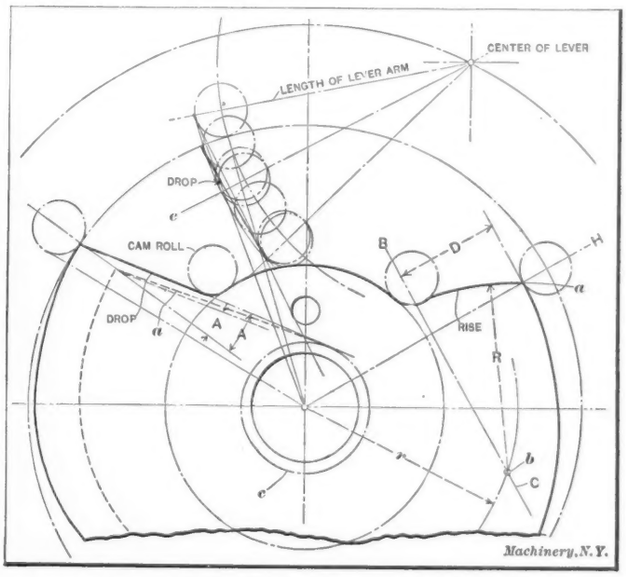


Fig. 4. Method of Laying out Rise and Fall on Cams

to lay out a uniform curve for the rise, as in most cases the cam rotates slowly, but when the cam is required to make one revolution in less than 5 seconds on the No. 0 or No. 2 screw machine, a curve of a more uniform speed should be constructed.

Generally the rise can be abrupt for about three-quarters of the way up and then gradually slow down as the tool approaches the work. An efficient method of laying out a curve of this form is shown in Fig. 4. The reason for making a curve of this form is that less time is necessary for

one tool to clear another which sometimes makes quite a considerable difference in the time required to produce one piece, this, of course, totaling up in the day's work. To construct the rise, refer to Fig. 4 and proceed as follows: Lay off on line H a distance D from the point a. Then through the point where an arc having a radius equal to D would cut the line H, draw the line BC at right angles to it. With a as a center, and a radius R describe an arc cutting the line BC at the point b; again with R as a radius and a center b describe the rise. Join the rise and the smallest diameter of the cam with a circle equal to the diameter of the roll. The distance r should then be measured off and recorded on the drawing to be used by the toolmaker when laying off the cams. The various values for the reference letters as given in Fig. 4 for the rise have been found suitable for the seconds to make one piece, and are specified in Tables II, III and IV.

Constructing Drop on Cams

The drop on the cams should be such that the cross-slides will drop back without shock. The turret slide drops back on a cushion spring, thus allowing the drop on the lead cam to be more abrupt, on the No. 0 and No. 2 screw machines, than it is on the front and rear cams. This is also true of the No. 00 machine, but as the drop is not great very little time would be saved by using a smaller angle of drop for the lead than for the cross-slide cams. Referring to Fig. 4 it can be seen that the lever arm swings in an arc so that to have a

TABLE IV. DIMENSIONS FOR LAYING OUT CAM RISE FOR NO. 2 BROWN & SHARPE AUTOMATIC SCREW MACHINE

Number of Seconds to make one Piece	Lead		Front and Back Cams	
	D	R	D	R
From 6 to 14 seconds..	$1\frac{7}{8}$	$2\frac{7}{16}$	$1\frac{1}{2}$	$1\frac{3}{4}$
From 15 to 40 seconds..	$1\frac{3}{4}$	$2\frac{3}{8}$	$1\frac{1}{4}$	$1\frac{13}{16}$
From 45 to 90 seconds..	$1\frac{1}{2}$	$2\frac{1}{16}$	$1\frac{1}{16}$	$1\frac{5}{16}$
From 100 to 180 seconds.	$1\frac{3}{8}$	$3\frac{1}{4}$	$\frac{15}{16}$	$2\frac{3}{16}$

uniform drop a harmonic curve should be constructed. But, as this drop would be more difficult to make than a straight drop, a straight or angular drop is adopted. This gives the drop of the arm a variable motion, as can be seen by referring to Fig. 4; the roll will drop quickly to about the point e, then slow up and then increase in speed as it approaches the bottom. The cross-slides are forced back by a spring which serves to keep the roll in contact with the cam. The drop on the cam should not be laid off from a circle as shown by the dotted lines at c. This would mean that the roll would drop slower when dropping a short distance than when dropping a greater distance. The drop should be laid off from the hundredth line where the operation finishes as shown by the angle A. This assures the drop always being the same speed irrespective of the distance through which it has to drop. The following angles of drop have been found suitable for the number of seconds required to make one piece as specified in Tables V, VI and VII.

TABLE V. DROP ON CAMS FOR NO. 00 BROWN & SHARPE AUTOMATIC SCREW MACHINE

Number of Seconds to make One Piece	Lead, Front and Back
From 3 to 5 seconds	$A = 20$ degrees
From 6 to 12 seconds	$A = 15$ degrees
From 13 to 30 seconds	$A = 10$ degrees

TABLE VI. DROP ON CAMS FOR NO. 0 BROWN & SHARPE AUTOMATIC SCREW MACHINE

Number of Seconds to make One Piece	Lead	Front and Back
From 5 to 12 seconds	$A = 17$ degrees	16 degrees
From 13 to 30 seconds	$A = 14$ degrees	13 degrees
From 32 to 60 seconds	$A = 10$ degrees	9 degrees

TABLE VII. DROP ON CAMS FOR NO. 2 BROWN & SHARPE AUTOMATIC SCREW MACHINE

Number of Seconds to make One Piece	Lead	Front and Back
From 6 to 14 seconds	$A = 16$ degrees	22 degrees
From 15 to 40 seconds	$A = 14$ degrees	19 degrees
From 45 to 90 seconds	$A = 12$ degrees	16 degrees
From 90 to 180 seconds	$A = 10$ degrees	13 degrees

Clearance for Tools

In laying out a set of cams it is sometimes found necessary to make allowance for one tool to clear another, the amount of clearance necessary being determined by the diameter or width of tool used in the turret and the position of the cross-slide tools relative to the work. When determining the amount of clearance necessary, the rise and drop on the lead cam is disregarded and the rises and drops on the front and rear

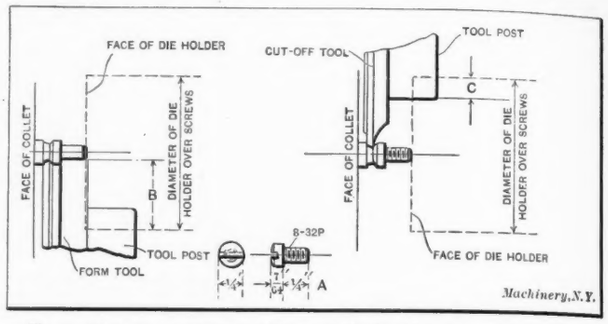


Fig. 5. Diagram Illustrating Method of Finding Clearance for Die Holder

cams are taken into consideration. To determine the rise and drop to use, make a rough lay-out of the various operations to be performed and also obtain the approximate number of revolutions to complete one piece. The revolutions are then converted into seconds as was previously explained and the rise and drop used as specified in a foregoing section. To explain clearly the method used, we will take a practical example. Assume that it is required to make a brass screw as shown in Fig. 5. This screw is made from ¼-inch round brass rod, and can be made to advantage on the No. 00 Brown & Sharpe automatic screw machine using a spindle speed of 2400 R. P. M. backward and forward. Assume that it is required to find the amount of clearance necessary for the die holder to pass the circular form and cut-off tools. To proceed, draw in the form tool in position on the screw as shown to the left in Fig. 5, and also an outline of the tool-post. Then lay out the die holder in position to start on the screw as shown by the dotted lines. If a releasing die holder is used, take the diameter over the head of the screw, but if a "draw-out" type is used, the diameter of the cap is taken. In

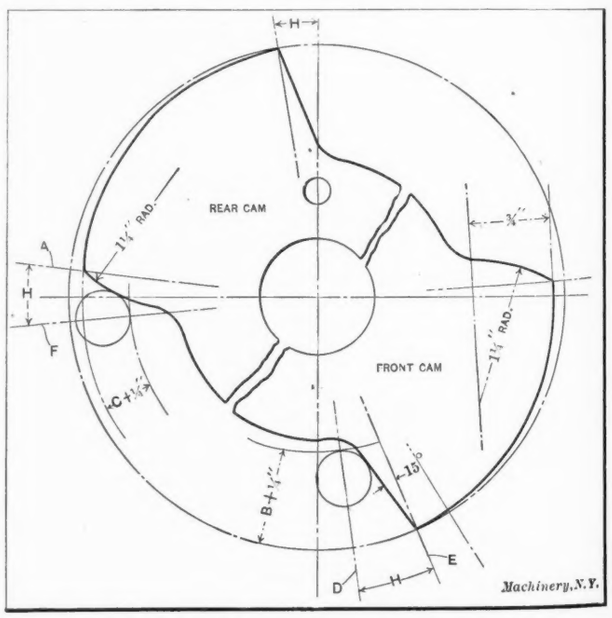


Fig. 6. Method of Determining Clearance on Cross-slide Cams

this case, as the screw is threaded up to the shoulder, a releasing die holder will be used. Referring to Fig. 5, it can be seen that the die holder cannot advance on the screw until the form tool drops back equal to the distance B, but as B is the actual distance, it will be necessary to add an extra amount to insure the die holder's advancing without coming in contact with the circular form tool. The extra amount of

clearance necessary varies with the type of tool used. The following dimensions give the approximate amount which should be added to the actual clearance for the type of tools as specified:

Type of Tool	Extra Amount of Clearance
Drill holders	from 1/8 to 3/16 inch
Box-tools (with V-supports)	from 1/8 to 1/4 inch
Box-tools (with supporting bushing)	from 3/16 to 5/16 inch
Button die holders (draw-out type)	from 3/16 to 5/16 inch
Button die holders (releasing type)	from 1/4 to 1/2 inch

To find the amount necessary for clearance make a diagram as shown in Fig. 6, laying out the drop on the front cam as shown. Then add, say, ¼ inch, to the dimension *B* and measure down from the point where the lobe finishes, as shown. Then with a radius equal to the radius of the cam roll, describe a circle touching the line as drawn and the drop on the cam. Join the center of the roll with the center of the cam circle by a straight line. The clearance is then measured off in hundredths as shown by dimension *H*. The starting point of the lobe on the lead cam for threading will be at the hundredth line *D* and the intervening space between the lines *D* and *E* will be the amount necessary for clearance.

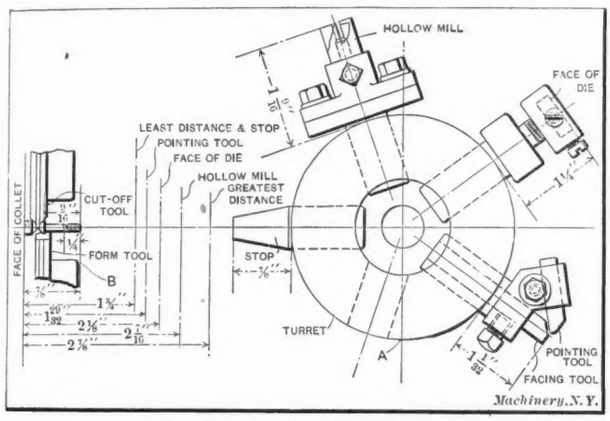


Fig 7. Position of Tools in Turret, and Forming Tools applied to Work

When the cutting-off operation follows the threading operation it will also be necessary to allow for clearance. To find the amount of clearance necessary for the die holder to clear the circular cut-off tool, proceed as follows: Make a lay-out as shown to the right in Fig. 5 and measure off the distance *C*. Add ¼ inch to this and lay this dimension off from the starting point *A* of the rear cam as shown in Fig. 6. Then draw in a circle equal to the diameter of the roll touching the line drawn and the rise on the cam, and measure off the clearance *H* as was previously explained. The thread lobe would finish at the hundredth line *F* and the cut-off tool start at the line *A*. Clearance should also be allowed between the dropping back of the cut-off tool and the feeding of the stock. To find the amount of clearance necessary add ⅛ inch to the largest radius of the stock used and proceed as was previously explained.

To make this article more complete, the various steps followed when designing a set of cams will be given, starting at the first and covering each step until the drawings of the cams are completed.

Designing and Laying out Cams

When designing a set of cams the speed of the spindle best suited for the size of stock and nature of material should first be decided on. The formulas for finding surface speeds given in the July number of MACHINERY will be found convenient for this purpose. The quickest and best method of making the piece should next be considered and a diagram made of the tools to be used in the turret as shown at *A*, Fig. 7, leaving from 1/8 to 3/16 inch clearance between the rear face of the tool holder and the face of the turret. This amount, of course, varies to a considerable extent, depending on the length of the shank and body of the tool, and also on the distance that the work projects from the chuck. When the shank of the tool is short, care should be taken to see that the clamping devices in the turret have a good grip on the shank of the tool. The diagram of the circular tools applied to the work should also be made as shown at *B*, Fig. 7. The feeds for the various operations are then decided on and divided into the length of cut which will give the number of revolutions required for the various operations. The total number of revolutions to complete one piece is found by adding together the number of revolutions for each cut, for revolving the turret, feeding the stock and in some cases reversing the spindle; an approximate number of revolutions should also be added for clearance. When the approximate number of seconds to complete one piece has been obtained we then make a diagram of the rise and drop on the cam as shown in Fig. 6. To ascertain the exact number of revolutions required for clearance, if the approximate number of revolutions as allowed for clearance is not sufficient, the feed on some of the tools is increased, but if the maximum feed that the tools will stand has been used, the number of seconds to make one piece has to be increased. When the actual number of seconds has been obtained, we then convert the revolutions for each operation into hundredths and proportion the different lobes on the cam to the number of revolutions for each operation. To explain the method adopted in laying out the cams, we will take a practical example. Assume that it is required to make a screw as shown at *B*, Fig. 7. We first make the diagrams of the circular tools and the tools used in the turret as shown. Then to find the amount that the lead cam is to be cut down below the outer cam circle, measure the distance that the tools project out of the turret and add this amount to the distance that the piece projects from the face of the chuck. Then the least distance between the turret and the face of the chuck subtracted from this amount would give the distance down from the outer circle to where the lobe on the cam starts. For example, take the lobe for the hollow mill. 1 9/16 + 7/8 = 2 7/16 inch. 2 7/16 inch — 1 3/4 inch = 11/16 inch. In Fig. 8 is given a method of laying out the cams for the screw shown in Fig. 7. This method is commendable, as it can be seen whether the tools will clear one another better than if the cams were drawn separately instead of one on top of the other. If the foregoing suggestions are followed, the writer is confident that very little trouble will be encountered in designing a set of cams. The example as given is for making screws, but the same method can be followed in making any other class of work.

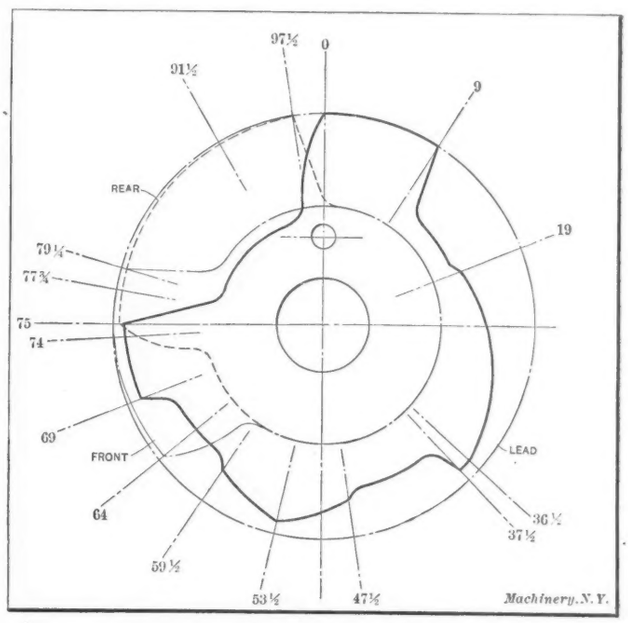


Fig. 8. Commendable Method of Laying out Cams

After the cams have been designed, a tracing should be made and kept for reference. In Fig. 9 is shown a cam drawing as adopted by the Northern Electric & Mfg. Co., Montreal. (The illustration here shown is about half size.) The cams for the No. 00 machine are drawn full size and the cams for the No. 0 and 2 machines are drawn half size, the same size of sheet being used for each. All the other neces-

sary information is put on this drawing, which has been found very convenient. It might be well to mention here that there are three prints made from this tracing. One print is kept in the designing department, one sent to the tool-room and the other is sent to the automatic screw machine department.

Practical Points in Designing Cams and Special Tools

1. Use the highest spindle speeds that the various tools will stand.

2. Use the arrangement of circular tools best suited for the class of work. (See MACHINERY, March, 1910.)

3. Decide on the quickest and best method of arranging operations before designing the cams.

the cut-off tool should be increased until near the end of the cut where the piece breaks off. After it breaks off, the feed should then be increased to pass the center.

11. When a thread is cut up to a shoulder, the piece should be grooved to make provision for the lead on the die. This requires an extra projection on the form tool and also an extra amount of rise on the cam.

12. Use circular form and cut-off tools made from high-speed steel when cutting Norway iron, machine steel, etc.

13. Use a fine feed and high spindle speed for all cutting tools.

14. Allow sufficient clearance for tools to pass one another.

15. Always make a diagram of the cross-slide tools in posi-

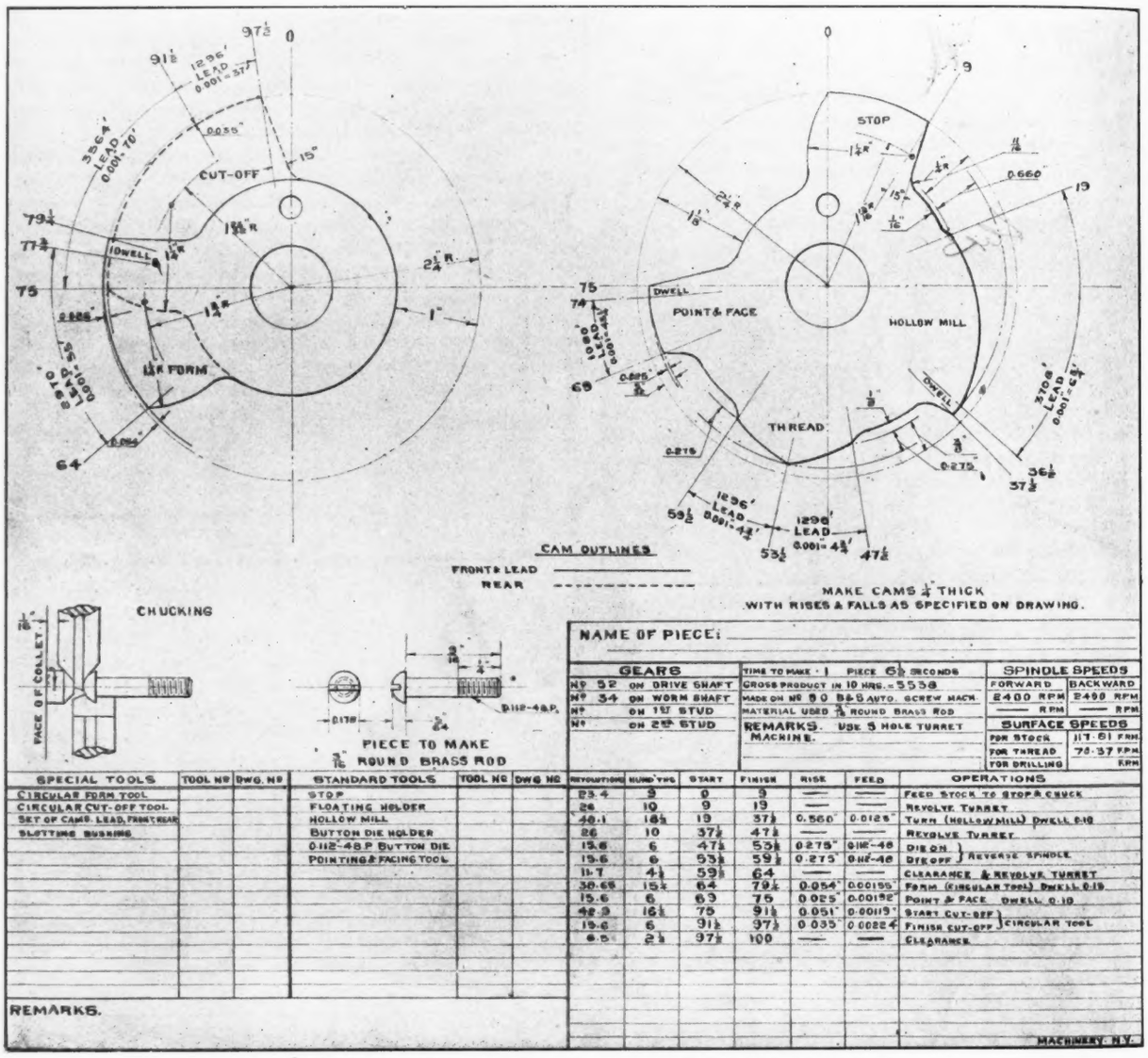


Fig. 9. Standard Cam Drawing adopted by the Northern Electric & Mfg. Co., Montreal

4. Do not use turret tools for forming when the cross-slide tools could be used to better advantage.

5. Do not use a circular cut-off tool without top rake when cutting Norway iron, machine steel, etc. (See MACHINERY, April, 1910.)

6. Make the shoulder on the circular cut-off tool large enough so that the clamping screw will grip firmly. (See MACHINERY, April, 1910.)

7. When chips clinging to the work are objectionable, the circular form tool should be turned up-side-down and placed on the rear cross-slide. (See MACHINERY, March, 1910.)

8. Do not use too narrow a cut-off blade. (See MACHINERY, March, 1910.)

9. Allow 0.005 to 0.010 inch for the circular tools to approach the work and 0.003 to 0.005 inch for the cut-off tool to pass the center.

10. When cutting off work large in diameter, the feed on tion on the work when difficult operations are to be performed; it is also necessary to make a diagram of the tools held in the turret.

16. Do not drill a hole more than 2½ times the diameter of the drill, but use two or more drills as required. If there are not sufficient holes in the turret, just drop the drill back clear of the hole.

17. Do not run a drill at a slow speed. Use a Brown & Sharpe drilling attachment.

18. When the turret tools operate in further than the face of the chuck, see that they will clear the chute when revolving the turret.

19. See that the body of all turret tools will clear the side of the chute when revolving the turret.

20. Do not use a box-tool for a roughing cut. Use a hollow mill.

21. Do not use a box-tool with soft supports.

22. The rise on the thread lobe should be reduced so that the spindle will reverse when the die or tap holder is drawn out. (See MACHINERY, June, 1910.)

23. When threading Norway iron, machine steel, etc., if the spindle speed used for the other tools is too high for threading, use the various threading attachments as described in MACHINERY, June, 1910.

24. When bringing another tool into position after a threading operation, allow clearance before revolving the turret.

25. Make provision to revolve the turret especially when pieces are being made in from three to five seconds and when only a few tools are used in the turret. It is sometimes convenient to use two sets of tools.

26. When using a belt-shifting attachment for threading, clearance should be allowed, as it requires extra time to shift the belt. (See MACHINERY, June, 1910.)

27. When laying out a set of cams for operating on a piece which requires to be slotted, cross drilled or burred, allowance should be made on the lead cam so that the transferring arm can descend and ascend to and from the work without coming in contact with any of the turret tools.

28. Always allow a vacant hole in the turret when it is necessary to use the transferring arm.

29. Use standard tools whenever possible.

30. When designing special tools allow as much clearance as possible. Do not make them so that they will just clear, as errors sometimes turn up causing trouble.

31. When designing special tools having intricate movements, avoid spring as much as possible and use positive actions.

* * *

LOCATING HIDDEN BOLT HOLES

By H. E. WOOD*

Occasionally it is necessary, particularly in connection with repair work, to locate and lay out bolt holes that come under brackets or in hidden places where they cannot be gotten at from the opposite side to lay them out with a scriber. There are several methods which can be successfully employed for work of this kind, some one of which will probably be applicable to almost any case that comes up in general shop work.

One approved method is to use studs *A* having projecting centers as shown in Fig. 1, there being a sufficient quantity of these studs to place one in each hole that is to be laid out. In this particular case the holes in the part *C* have been drilled and tapped, and it is required that corresponding holes be drilled in bracket *B* which must be attached to some other member of the machine; that is, it is necessary to lay out on bracket *B* holes which are completely covered by it. To do this the studs *A* are screwed in the holes in *C* just far enough to allow the sharp center points to project slightly beyond the surface *c*. Then when the bracket *B* is placed in position, evidently the points of the studs will hold it slightly above the surface of *C*. By giving bracket *B* a light blow with the hammer, it can easily be seen that the point of each stud will form an accurate center from which the bolt holes may be laid out. These studs should be made in the lathe so that the sharp points will be central, and a screw-driver slot should be cut across one side, as shown, to facilitate their insertion.

Another approved method would be to place the bracket (or other part) in the correct position and then with a scriber make a distinct line around the sides of it on the finished surface. When the bracket is removed, the location of the holes is transferred to it by measuring from the scribed lines to the holes and transferring these measurements to the bracket. The measurements in each case should be at right angles to the lines and edges of the bracket.

In case the corners of the part are rounded, as illustrated in Fig. 2, or the edges ragged or uneven, so that the method just referred to cannot be used with accuracy, the work may be laid out as follows: Scribe two lines *a* at right angles on the body or frame part, and two other lines *b* on the bracket, parallel to the first, the two sets of lines being any convenient distance from each other. The holes are now transferred to the bracket practically the same as described in the preceding paragraph, except that when the measurements are transferred to the bracket, the distances *x* between the parallel lines must, of course, be subtracted.

Another method that may be used (although not very accurate) is to fit plugs in the holes, letting the ends project slightly above the surface. The end of these plugs should be smeared with paint or chalk, after which the bracket is placed in position. If the bracket is rapped a few times with a hammer, it will be found upon removal that the paint or chalk will have made a mark, thus locating the hole. When this method is employed, it is best to first drill small holes, then place the work in position to see if these under-sized holes

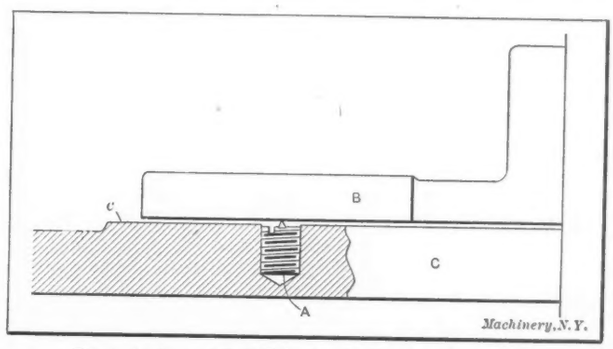


Fig. 1. Laying out Bolt Holes by the Use of Pointed Studs

are central. If they are not, there is still a chance to change their position before re-drilling to the correct size.

Still another method which is somewhat inaccurate, but which sometimes answers the purpose, is to lay the ball-peen of a hammer in each of the original holes and then strike the hammer face with another hammer which will raise a slight burr around the holes. If the underside of the bracket surface is then chalked and placed in position, the raised burrs will mark the chalked surface if the bracket is lightly tapped a few times with the hammer. The drill-and-try method mentioned should also be used when this method is employed.

Hidden bolt holes may also be laid out with a fair degree of accuracy by laying a small string, which has been saturated with paint, on the surface containing the holes so that

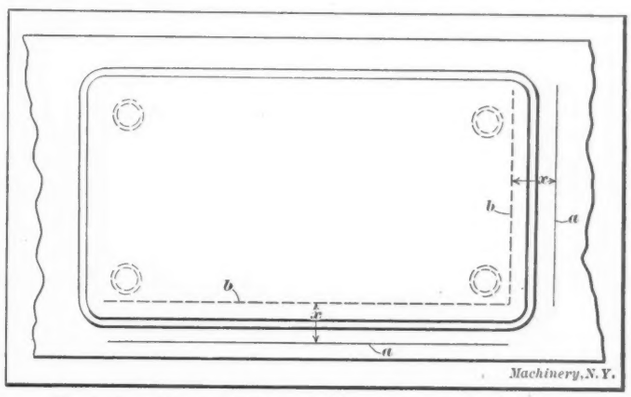


Fig. 2. Locating the Position of Hidden Holes from Scribed Lines

it forms a right angle as shown by the dotted lines *b* in Fig. 2. Now when the bracket is in position and hammered lightly or a heavy weight placed upon it, the paint on the string will make a mark on the bracket which may be used the same as lines, the holes being transferred as previously described.

Another way to locate centers by the use of lines is to first scribe lines at right angles across the centers of the holes. When the bracket is located, lines should be located on its edge to coincide with those previously scribed. The bracket is then removed and a straightedge is used to lay out lines at right angles on it. The intersection of these lines will indicate the centers of the holes.

Holes may often be transferred by the use of a paper templet. This is made by laying a sheet of heavy paper on the largest of the two surfaces. The sheet is then cut, by going around it with a hammer, to fit the edges exactly whether they are straight or ragged, and the holes are also cut by the use of the peen of the hammer. Next place the small piece or bracket on the paper, which is still in position, and mark around the edges with a pencil. These lines are then used for locating the paper templet when laying out the holes.

* Address: 182 North 4th St., Newark, N. J.

Copyright, 1910, by THE INDUSTRIAL PRESS

Entered at the Post-Office in New York City as Second-Class Mail Matter

MACHINERY

DESIGN—CONSTRUCTION—OPERATION

PUBLISHED MONTHLY BY

THE INDUSTRIAL PRESS

49-55 LAFAYETTE STREET, CORNER OF LEONARD
NEW YORK CITY

Alexander Luchars, President and Treasurer
Matthew J. O'Neill, Secretary

Fred E. Rogers, Editor.
Erik Oberg, Franklin D. Jones, Ethan Viall,
Douglas T. Hamilton,
Associate Editors

The receipt of a subscription is acknowledged by sending the current number. Checks and money orders should be made to THE INDUSTRIAL PRESS. Money enclosed in letters is at the risk of the sender. Changes of address must reach us by the 15th to take effect on the following month; give old address as well as new. Single copies can be obtained through any newsdealer.

We solicit exclusive contributions from practical men on subjects pertaining to machine shop practice and machine design. All accepted matter is paid for at our regular space rates unless other terms are agreed on.

AUGUST, 1910

PAID CIRCULATION FOR JULY, 1910, 26,185 COPIES

MACHINERY is published in four editions. The practical work of the shop is thoroughly covered in the Shop Edition, $1.00 a year, which comprises approximately 700 reading pages and 36 Shop Operation Sheets, containing step-by-step illustrated directions for performing 36 different shop operations. The Engineering Edition—$2.00 a year, coated paper $2.50—contains all the matter in the Shop Edition, including Shop Operation Sheets, about 300 pages a year of additional matter and forty-eight 6 x 9 Data Sheets filled with condensed data on machine design, engineering practice and shop work. The Foreign Edition, $3.00 a year, comprises the same matter as the Engineering. The Railway Edition, $2.00 a year, is a special edition including a variety of matter for railway shop work—same size as Engineering and same number of Data Sheets.

DATING ADVERTISING MATTER

It is the custom for manufacturers purposely to omit from their catalogues and other printed matter the date of publication, because the date tells the age, which is undesirable in matter that is old. Where a manufacturer issues a catalogue only once in three or four years, this reason for omitting the date may be sufficient, but we hardly think it is. Of course it is true that the recipient of a catalogue bearing an old date might feel that an old edition had been sent to him instead of the latest issued. Aside from this, is there a good reason for not dating all advertising matter issued by a manufacturing concern?

All things considered, we believe it is preferable generally, no matter how infrequently a firm's catalogues are issued, to show the year and month of publication. The dating of advertising matter is of value to the manufacturer as well as to the prospective buyer. A date has historical significance, and often is of much value in a legal contest where it might otherwise be difficult to establish proof of the time when a product was put on the market. By all means date your advertising literature, and then issue it often enough so that you will not be ashamed to have the last dates known.

* * *

GETTING THE BEST RESULTS FROM EXHIBITIONS

Manufacturers in general seem to agree that exhibitions limited to one class of products are more effective than large industrial fairs which include many kinds. The specialized exhibition or show is becoming recognized as an effective means of advertising, and it is highly important that manufacturers who spend considerable sums of money exhibiting their products at these fairs should derive the greatest possible benefit from them. The same care should be given to all the details connected with such exhibitions as is given to the general advertising and selling of machinery, and the same principles should be observed. The exhibition should be necessarily of a character to attract the attention of the visitor, and when the attention has been attracted to demonstrate the value of the machines and devices shown. In order to do this, it is necessary to have a man of high ability in charge. Any young man from the sales department will not do. The man in attendance at an exhibition should be thoroughly familiar with the mechanical construction and operation of the machines exhibited. He should be able to explain their advantages in a simple and clear way to persons not familiar with the machines shown, and in a technical manner to the trained mechanical man. Besides, he should be a first-class salesman. If such men were always put in charge of exhibitions it is certain that the returns would be greater than otherwise, and the common complaint of manufacturers that exhibitions at fairs and shows do not pay, would be largely eliminated.

To sum up, it should be remembered that an attractive exhibition is not enough; advertising which merely attracts the eye but does not appeal to the intelligence of the prospective purchaser is not of the highest standard. The additional cost incident to improving the exhibition advertising so that it will be effective is much less, in proportion, than the initial cost. It is poor policy to spend a large amount of money on space rent, decorations, freight charges, installation, etc., and then to defeat the object in view by placing an incompetent man in charge.

* * *

DEFECTS IN MACHINERY DEVELOPED AFTER SHIPMENT

A thorough inspection system will disclose faults in machine construction and so provide for their correction that the product at time of shipment will be O. K., but no inspection could provide against defects that sometimes develop between the time of shipment and receipt by the buyer. A few cases in point will serve to illustrate:

Several years ago a machine tool builder shipped four engine lathes which had been thoroughly inspected, particularly as to truth of spindles. After the lathes were set up in the buyer's shop the spindles were found to be badly out of truth, and a hot letter of complaint was forthwith sent to the builder. The superintendent of the maker's shop who had personally witnessed the tests of the spindles could not believe the report, and went himself to find out the cause of the trouble. Sure enough the test-bar ran out several thousandths in every spindle!

The dumbfounded superintendent could not remedy the trouble nor give an explanation. He finally had the lathe heads removed and shipped back to the shop. There a careful investigation showed that the keys holding the head gears on the spindles had been fitted too tight, but the tight fit had not sprung the spindles appreciably until they had been subjected to the vibration and jar of the railroad trip. Reducing the keys slightly allowed the spindles to readjust themselves and run true.

Another case is that of a planer built by a well-known concern, which was received with the bed sprung so that at corners diagonally opposite the ways were one-sixteenth inch low. The buyer, fortunately a machine tool builder himself, set out to discover the cause of the fault. It was simple. The bed had been crated properly but badly placed on the car, the consequence being that one corner was unsupported. A long railroad trip with many delays had resulted in causing the corner to settle by its own weight and the metal had taken a permanent set. Instead of making the planer manufacturer trouble, the buyer simply set the bed on supports and loaded it so as to spring it back into shape. It required several days to accomplish this, but it was done with perfect satisfaction.

If users of accurate machinery fully appreciated that the heaviest machine members acting as a beam or cantilever can be deflected by the mere pressure of the hand and that the deflection of the beam is proportional to the stress up to a certain limit, the need for properly setting and handling machinery parts not intended to act as beams would be better understood. Nothing is so stiff that it does not bend under load. Lack of support or improperly placed supports will invariably cause trouble in machine tool use.

KEY-OPERATED DRAFTING MACHINE

We have often been impressed with the need of a simpler and more rapid means of making mechanical drawings, especially for inventors and designers. Ideas come quickly and sometimes vanish as suddenly as they come. They have to be brought down while on the wing, as it were, and the faster the pencil moves, the more accurately will the details be recorded.

Literary men know how laborious and unsatisfactory is the writing out of ideas with the pen, in long hand. A man thinks faster than he can write and some of the happiest phrases are lost before they can be written. The typewriter has made it possible to write almost as fast as one thinks, and it is a great conserver of ideas as well as a saver of time and labor. The expert operator becomes practically unconscious of his fingers which automatically strike the keys and write his thoughts.

Now, if some ingenious inventor would design an easily worked key-operating drafting machine with which his ideas could be graphically put on paper without the drudgery of measuring and using instruments, what a boon it would be to many. At the stroke of a key or combination of keys, a center line would be drawn and then in rapid succession would follow other lines in just the proportions the designer has fixed them in his mind, and in the correct relative positions. The drafting machine has greatly reduced the labor of making drawings but still leaves much to be desired. Is it too much to expect that something of the kind outlined, limited perhaps to drawings of small size, will be available in the not distant future?

* * *

OBSOLETE METHODS OF LARGE CORPORATIONS

Most mechanics whose duties or interests have led them to make visits to machine shops engaged in other lines than machine tool building, have doubtless been surprised to note the scarcity of some of the most highly developed forms of machine tools in the shops of the half dozen or so great manufacturing corporations, most of which were originally formed by the combination of smaller units. In such shops the standard design of engine lathe, for instance, still holds sway for large quantities of work which in smaller plants is profitably performed on turret lathes and chucking machines of the hand and automatic types. This condition can be described in no other way than as a tendency; but in some of the shops this tendency is very strongly marked.

The fundamental reason for it probably springs from the very conditions which make such corporations possible. Most of them have, to a greater or less extent, placed themselves beyond competition. The success of the concern may be built on a natural monopoly involving the supply of raw material, on an artificial monopoly in the form of patents, on financial connections which control important markets, on a superior selling organization made possible by the completeness of the line produced, on the careful cultivation of the territory, or on all these conditions combined. In few cases, probably, does such a concern attain and hold its position on account of superior ability in manufacturing. High development in this particular is naturally found in smaller shops, where the brightest minds of the concern are intimately in touch with the processes of manufacture, and constantly thinking out improved methods.

The significant feature of this condition is that very little pressure is brought to bear on such large companies to reduce the cost of production. In competition with smaller firms, more highly developed in this particular, the big concern possesses overwhelming advantages, like those enumerated above, which have produced its present preëminence. In what little competition there may be with other large corporations, similarly situated in respect to such advantages, the cost of production does not have to be carefully considered, because all the competitors are likely to be on the same footing.

This condition results in a tendency to cling to the older methods of manufacturing which do not call for such a high degree of administrative skill, or such close attention to details on the part of the manager. In completing a lot of machines, for instance, the old-fashioned way is to make up only a sufficient number of each of the parts to complete the lot, even though there is every probability that succeeding lots of the same machines will be required, and although many of the parts could be made cheaper in larger quantities. On machinery built in this way the selling cost is determined by keeping track of the cost of labor, material and overhead expense, and adding to them the desired profit. Economic conditions require nothing further, and this arrangement simplifies and makes possible the difficult task of managing a very large manufacturing enterprise.

But it should be possible, and it will become necessary, to avoid such economic waste. In time the smaller and better organized works will secure some of the commercial advantages of the larger organizations; and the latter, under the pressure of competition among themselves will be forced to adopt more economical methods.

* * *

THE VALUE OF BEING WELL INFORMED

An authority once said: "The best informed man does not always get the most money, but he usually holds his job the longest." There is a great deal of truth in this saying, and it would be well if young men, especially, could realize that the value of knowledge and experience is not measured by the temporary pecuniary returns only, but also by the advantage of being able to satisfactorily fill a secondary position until a greater opportunity offers. There are many men who are able to obtain good positions on the strength of their own representation of their ability, but who are not able to keep their jobs for any length of time, owing to the fact that the foundation of knowledge and experience on which they build is not substantial enough. In the long run those men are losers as compared with the man who does not attempt to obtain positions which he knows he cannot fill, and who perhaps for the time being seems to lag behind. Meanwhile, however, this man may be storing up knowledge and experience gained by faithful application to the kind of work for which he at the time is best fitted, and in due course he is likely to find himself called upon to fill a position which in responsibility and compensation will amply repay him for the efforts and sacrifices he has made in acquiring a thorough training in his work.

The ambitious young man who tries to increase his usefulness by acquiring an education in his chosen trade should not be discouraged if he finds that his knowledge and labors are not immediately rewarded. The knowledge he acquires is sure to be appreciated some day, and when a specially trained man is needed, the one who has fitted himself for the work to be done is the most likely to be considered. Eliminating the cases where "pull" and personal favoritism have been responsible for the advancement of persons not actually fitted for the positions to be filled, it is safe to say that most of the responsible places in shops, drafting-rooms and business offices are filled by the men who ten, fifteen or twenty years ago most earnestly endeavored to acquire a greater and more comprehensive knowledge of the occupation in which they were engaged.

* * *

In the Eastman Kodak Co.'s plant on State St., Rochester, N. Y., is an ingenious device for measuring the area of hides. The company purchases large quantities of leather for covering cameras and the machine is used for determining the hide areas. It consists essentially of a wooden frame carrying several hundred metal pins, hinged at the back and suspended on a weighing scale having a pointer which indicates square feet area on its face, instead of pounds. The pins vary in weight, the lightest ones being at the back near the hinge of the frame and the heaviest ones in front. Their weight is proportional to their distance from the pivot. The pins two feet from the pivot, for example, weigh only one-half as much as those one foot away from the pivot, and so on. In operation the frame is raised and the hide is laid underneath the frame which is then let down. The weight of the pins resting on the hide is subtracted from the total weight, thus indicating on the scale the square feet in the hide.

MACHINING ACCURATE QUICK-PITCH SCREWS AND NUTS

By FRANCIS J. BOSTOCK*

Some time ago the writer had occasion to machine a considerable number of special quick-pitch screws and nuts having quintuple threads. The outside diameter of the screws was ¾ inch, with a lead of one inch. Fig. 1 shows the appearance of one of these screws and one of the nuts. (A quadruple threaded screw made in the same manner as the quintuple screw, is shown to the left.) The requirement was that all the screws and nuts should be absolutely interchangeable with each other. It is readily understood that this requirement presents considerable difficulties.

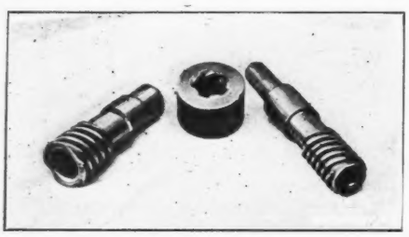


Fig. 1. Multiple-threaded Screws and Nuts made by Method Described

Several methods suggested themselves to the writer. One was the ordinary way of cutting the threads in the lathe, changing the gears around 1/5 of a revolution to give the requisite turn to the work so as to cut the next thread. Another method would have been to mill the screws in an ordinary milling machine and to arrange for some way of tapping the nuts by means of a master for giving the tap the correct turning effect while traversing the nut. This method, however, presents many difficulties, and would have caused the breaking of a considerable number of taps. The first method mentioned has the disadvantage of being slow, requiring the repeated starting and stopping of the machine, the thread being only about 2 inches long, and involving also the necessity of stopping the machine to change the gears. The use of a divisional driving plate would have introduced inaccuracies and loss of time. After careful consideration, therefore, the following method, which has proved itself to be quick and applicable alike to internal and external threads, was adopted. It insured all threads being cut exactly alike and the time of machining, as compared with the cutting of the threads in a lathe in the ordinary way, was reduced from 80 to 85 per cent.

The first step was to select a machine suitable for this work,

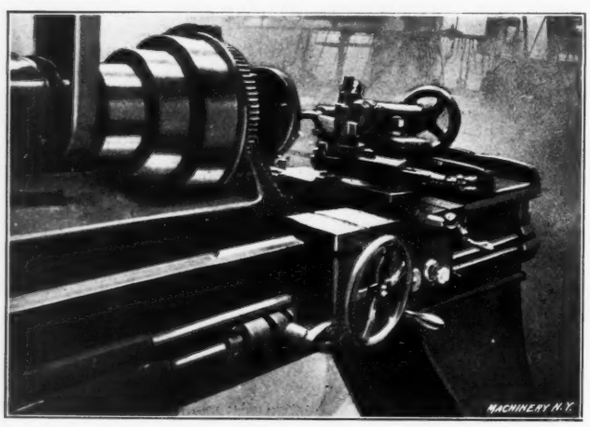


Fig. 2. Lathe Fitted with Master Cam for Cutting Multiple-threaded Screws

the feed shaft of which was driven directly from the feed screw, so as to enable this shaft to be driven at a predetermined ratio to the lathe spindle. On this feed shaft a cylindrical cam, capable of being adjusted to any desired position along the shaft, was fastened. This cam had a groove cut on its surface in which engaged a pin plunger extending from a bracket on the saddle or apron of the lathe. By this means the saddle could be moved forward or backward, as guided by the groove in the cam. The plunger could be let in or withdrawn from the groove as required. The groove in the cam was so arranged that the saddle would travel slowly while the thread was being cut, but return at an increased speed. The cam and work always revolved in the same direction, and it was only necessary to withdraw the tool on the completion of each cut and feed it in when beginning a new one. An adjustable stop was used for giving the requisite feed to the tool. The general arrangement is indicated in Fig. 2.

The interesting feature about the method described is that it was not necessary to stop the lathe until the threads on each piece were completely finished, the device having a provision for giving automatically the travel from one thread to the next, thus insuring all the screws being cut absolutely alike and made interchangeable with each other. Another valuable feature is that the saddle travels only just far enough to clear the work, and that as little time as possible is occupied in returning. All motions are independent of the operator, whose sole duty it is to feed and withdraw the tool for each stroke.

The master cam was designed as follows: The length of the threaded part of the work was 1¼ inch, requiring a movement of the saddle of about 1¾ inch. As the ends of the grooves in the master cam were to be rounded, the travel in the grooves should be, initially, about 2 inches. Assuming, therefore, that the saddle travels forward 2 inches, then the work must make $\frac{\text{travel}}{\text{lead}}$ revolutions, or, in this case, $\frac{2}{1}$ or 2 revolutions. Assume now that we decide to reverse in say 1 1/5 revolution; then the total revolutions of the work to one

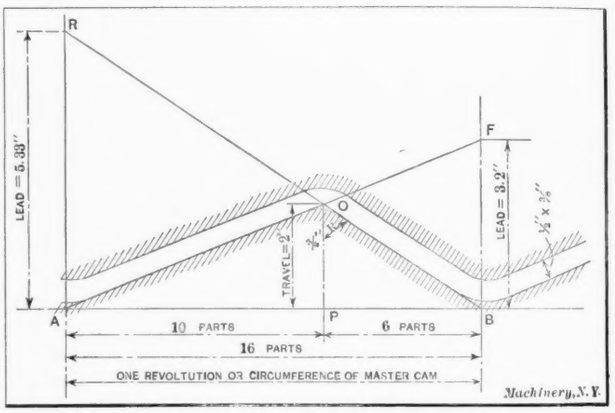


Fig. 3. Layout for Master Cam

revolution of the cam is $2 + 1\ 1/5 = 3\ 1/5$. A little consideration will show that each time the tool returns, it catches the next thread to the one having just been caught, because the work has advanced 1/5 of a revolution for each time the tool returns. In the illustration in Fig. 2 it will be seen that the master cam has two grooves. One of these grooves is used for screws of different lead, and is not required for the work being described.

We will now proceed to find the requisite lead for the cutting of the cam, the lay-out of which is indicated in Fig. 3. The line *AB* represents the circumference or one revolution of the master cam. This must be divided into the forward and reverse periods. The forward travel is represented by 10 parts and the reverse by 6 parts, the point *P* being the point of reversal. From point *P* draw line *OP* equal to the travel of the saddle, *i. e.*, 2 inches. Draw from the points *A* and *B* through the point *O* lines *AF* and *BR*. Now *AR* and *BF* equal the leads to which the groove in a master cam must be cut, the lengths of these lines being easily found by proportion.

$BF : 2 :: 16 : 10$; hence $BF = 3.2$ inches,
$AR : 2 :: 16 : 6$; hence $AR = 5.33$ inches.

The master cam is now set up in an ordinary milling machine and grooves milled to the leads found. It is advisable, however, not to mill the grooves exactly to their meeting point, but to produce an easy radius at their junction so as to reduce the strain of reversing the direction of the saddle.

After the master cam was cut and attached to the machine, the correct gears to drive the feed shaft in the right relation to the lathe spindle were determined. The ratio of the number of revolutions made by the work to the revolutions of the

* Address: 22 Bristol Road, Bournbrook, Birmingham, England.

master cam is 16 to 5, and from this ratio the gears are easily found.

The measuring of the external threads was made by the wire method, but as the outside diameter was standard, only one wire was used, the size being taken from one wire and the outside diameter of the screw. The internal threads were measured by means of an ordinary screw plug gage.

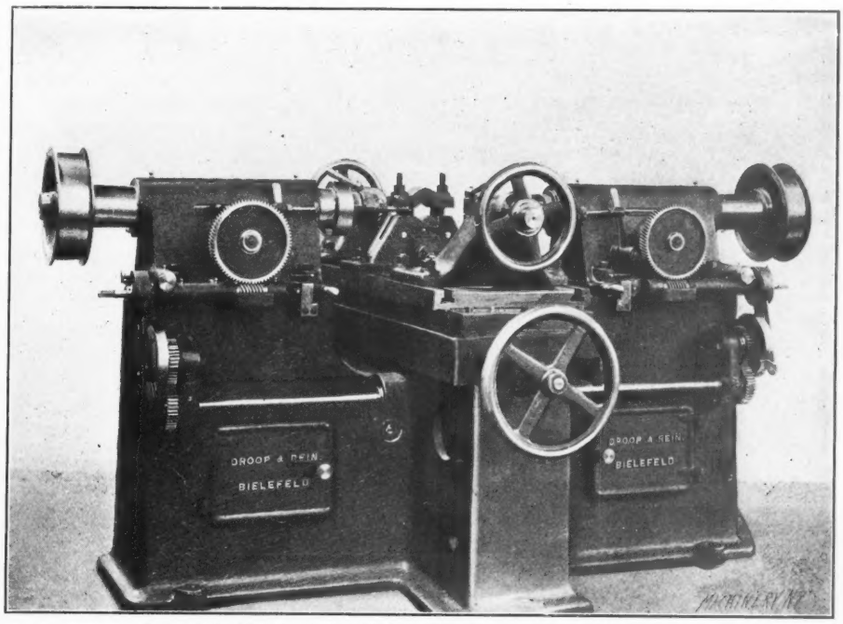
* * *

SPECIAL KEY-SLOT MILLING MACHINE

A special machine for milling slots and key-holes in shafts, bushings, cross-heads, piston-rods and similar pieces, is shown in the accompanying engraving. This machine has two horizontal spindles arranged on each side of the work-table so that the mills operate on both sides of the work simultaneously. The table is given a reciprocating motion by means of a slotted crank at the rear, and at the end of each stroke, the two spindles are fed in toward the center of the work. The stroke of the table is, of course, adjustable and it may be determined by a scale on the slotted crank.

The feeding movement for the spindles is transmitted from the drive at the rear through the bed, by shafts, which by means of spiral gearing, drive the horizontal shafts seen at the front of the machine. These shafts, through spur gears and a slotted crank and ratchet mechanism, actuate the worm and worm-wheels shown. The shafts on which the worms are mounted impart the movement to the spindles by a pinion that meshes with a rack cut in the spindle quills. This feeding movement, as before stated, takes place at the end of each table stroke. The feed can be varied by means of the slotted cranks, and it can be disengaged automatically at any predetermined point. The disengagement is brought about by a pin attached to the spindle quill striking an adjustable screw in a latch-lever which holds the worm into engagement with the wheel, the worm being mounted on a swiveling shaft as shown. As soon as the feed is thrown out, each spindle is automatically returned by a weight suspended from a pulley at the rear, mounted on the worm-wheel shaft.

When milling slots in solid pieces such as piston-rods, etc., the tools are prevented from touching each other at the center of the work, by adjusting the trip mechanism of one spindle so that it is withdrawn when within about 1/32 inch of the center. The other spindle is also automatically withdrawn after its milling cutter passes into the slot milled by the opposite tool.



Special Machine for Milling Slots in Shafts, Bushings, Piston-rods, etc.

Slots can be milled with either parallel or taper ends, though in the latter case a special swiveling table is used. The milling spindles are made of the best crucible steel and they are hardened and ground. The machine has a pump for supplying lubricant to the mills, which, after being used, drains to a reservoir in the lower part of the machine body.

The particular machine illustrated will mill slots up to 7⅞ inches in length, and it can cut a keyway 5⅝ inches long, 1 3/16 inch wide, and 3½ inches deep, in thirty minutes. The distance from the spindle centers to the main table is 11⅞ inches, and to the swiveling table 7⅞ inches, while the maximum distance between the spindle heads is 21 inches. This machine is the product of Droop & Rein, Bielefeld, Germany, who also manufacture two others of similar design. One of these is equipped with four spindles which adapts it to the milling of two slots simultaneously, while the other has two spindles, and is similar to the one illustrated, but is electrically-driven.

* * *

The legend "Patent Applied For" so often seen on manufactured machinery generally means that the inventor couldn't even get a combination claim patent—which is usually not worth the paper it is written on.

LABOR CONDITIONS IN AMERICAN AND GERMAN MACHINE SHOPS AND FOUNDRIES

By W. H. DOOLEY*

The German government recognizes the duty and exercises the right of regulating the metal trades in the interest of the employed, but in doing so it is careful to keep in view the equal duty of fostering national metal and engineering industries, and consequently the German law is in many respects much less stringent than the English and American laws, which seem to have been enacted under spasmodic influences, without conscious recognition of any principle. This might be explained by the fact that the German government has been obliged to cultivate the great metal and engineering industries with much care. Consequently, the German legislature has been obliged to strike a happy medium between two claims, that of the employed for protection and that of the community at large for the promotion of industrial enterprises, whereas in both America and England the necessity for encouraging manufactures has not hitherto existed, and the legislatures have merely, from time to time, taken up the duty of protecting the employed with such drags upon their actions as the private interests of employers have been able to effect. The protection, in short, has been all on one side. The time when this line could be pursued with safety in this country and England has now passed.

The metal-working manufacturing industries have come to such a delicate balance that the possibility of their toppling over must be taken into account, and consequently the interest of the community is concerned in any course which is likely to have that effect. It is certain that if our metal industries do not need encouragement from the legislative branch of the government they certainly do require protection from serious shocks. It is, therefore, instructive to note the careful manner in which the German government has struck this happy medium, and the results.

The most stringent regulations passed by the government are those affecting children and women, and it is in this respect that the state has clearly in view the interests of the community as represented by the employed. The total number of children under fourteen years employed in the metal trades in Germany was 1087, and 543 in the machine trades. These children are between thirteen and fourteen, and the hours of employment are restricted to six with half an hour interval for meals. Between fourteen and sixteen they may work not more than ten hours, they must have an hour's pause at midday and half an hour both in the forenoon and afternoon, unless their working day is not more than eight hours and no continuous spell exceeds four hours. During the pauses any

* Address: Lawrence Industrial School, Lawrence, Mass.

participation in the work of the factory or shop is forbidden, and even remaining in the rooms is allowed only when their own department of the work is brought to a complete standstill or it is impossible for them to go elsewhere.

When past eighteen they cease to be youthful workers and are under no special regulations except that all under twenty-one must be provided with a "work book" or register containing name, age, birthplace, nature of employment, date of engagement, discharge, and other particulars. All boys under eighteen are obliged to attend a continuation school for nine or ten hours during the week, where they receive instruction in the technical knowledge of their trade and religious instruction by their own clergyman. This time is taken out of the regular work-day without loss of pay. In a number of the larger engineering and machine shops no youthful workers were noticed by the writer.

Workmen may be fined to the extent of one-half their earnings except in cases of acts against fellow workmen, of offenses against morality, or against regulations, against maintenance of order and of security, etc., when the fines may be imposed to the full extent of the average earnings. All fines must be applied to the benefits of the factory workers, and generally go to the sick fund, but this does not affect the right of employers to obtain compensation for damage. Particulars of fines must be entered in a book, which is open to inspection by a government officer.

Every machine shop, foundry, or engineering establishment must have a set of rules hung up in an accessible place in each department stating the hours of work, with the regular intervals for meals, the time and manner of paying wages, the length of notice terminating employment and the conditions under which notice is unnecessary, and particulars of punishment, including fines and the objects to which they will be applied. Punishments which would wound self-respect or offend morality are inadmissible. These rules are equally binding on employer and employed, but before they are issued opportunity must be given to adult workers to express their views, and the rules with any objections must be submitted within three days of issue to the factory inspector, who may order amendments if the rules are not in accordance with the law or with special regulations. Punishments not in the rules cannot be imposed, nor can other grounds of dismissal be included in the contract.

It is a rare thing for a firm to have any differences with its workmen. Indeed, I was definitely informed by one firm that there had been only five cases of dispute in nine years, and these arose not from the workmen as a whole or any considerable number of them, but were cases of individual workmen making complaints. They have in Germany an institution corresponding to the Conseil des Prud'hommes in France, which they call in German "Gewerbe Gerichte," to which all cases of disputes of employes and employers of the metal industries are brought. The average number of cases tried by this bureau never exceeds 500 a year. The bureau consists of three or five people. The government appoints a chairman who is a lawyer and the representative of the employer and the employe. Sometimes two are selected instead of one. They try the case before them, but their decision is not final as is that of the arbitration board in this country. If a workman or employer does not like the decision it is only binding for two weeks. Then the workman may leave or the employer may discharge him. To illustrate a case: One of the workmen in an engineering firm thinks he should receive four marks more a week in wages. He goes to the firm and makes the demand. They refuse him. He appeals to the Gewerbe Gerichte. The Gewerbe Gerichte says, "No, do not pay it." The workman can leave at the end of a fortnight by giving a two week's notice, or if the decision is given in favor of the workman the firm is obliged to pay him the increase for two weeks at least and then they may give him a fortnight's notice by serving a legal notice.

Notice of termination of employment is usually a fortnight, but it may be dispensed with on the part of an employer on the following grounds: false representation, theft and other criminal acts; leaving work without permission or refusing to fulfill the contract; carrying fire or lights about contrary to orders; acts of violence or gross abuse directed against employer, his representative or family; willful damage; inducing members of employer's family or his representatives or fellow workmen to behave in a manner contrary to law or morality; inability to continue work; or an alarming disease. Similarly it may be dispensed with by the workers on corresponding grounds; and also for non-payment of wages in the prescribed manner; neglect to provide sufficient work for piece-workers; unprofitable prejudices; danger to life and health in the employment, which could not be inferred from the contract.

The provision of rules for the metal industries containing the foregoing and other particulars, legally binding on employers and employed, is a characteristically German method of doing business. It is in accordance with that respect for law and order which is such a marked feature of German life, and contributes materially, no doubt, to the smooth working of the metal and engineering industries. The rights and obligations of "work-giver" and "work-taker"—to use the excellent German terms—are publically defined and guaranteed by law. This conduces to tranquillity, and renders vague talk about "rights" palpably futile. The law cannot be changed by individual bullying on either side. The rate of wages is, of course, not included in the rules.

Before any foundry, machine shop or engineering establishment can be started it is necessary to give notice to the local authority. Similar permission is required for the erection of boilers, and especially noisy works. Apart from these particular provisions, the metal industries are subject to the following law:

Owners are bound to arrange and maintain workrooms, appliances, machinery and tools, and to regulate the working in such a way as to protect the workers from danger to life and health, so far as the nature of the business allows. Particular attention must be paid to the provision of sufficient light, ample air space and ventilation, and to the removal of dust arising from the work, of vapors and gases thereby developed, and of refuse incident to it.

Similarly, those arrangements must be provided which are necessary for the protection of workers against dangerous contact with machinery or parts of machinery or against other danger lying in the nature of the work, place of working, and particularly against the dangers which might arise from fire. This section is followed by one requiring the provision of arrangements for the preservation of morality and decency.

The proof of the pudding, however, is in the eating, and the test of a law is its execution. Do the German metal industries conform to the laws? They do—as regards health and comfort they are not to be excelled. The buildings are brick and in the larger plants, steel. The most striking feature of the metal and engineering plants is their clean, orderly and well-kept condition. These qualities are universal, and they extend to the dirtiest and the most untidy department of the trade—the foundry. The foundry in this country is usually a scene of dirt and disorder, unmitigated by any attempt to be tidy, and aggravated by an atmosphere heavy with smoke and gloom. The German foundries and machine shops were a revelation to me. They are as clean and well-kept and almost as light as any other shop. The remarkable order maintained is systematic, and in a large measure intended to promote the prevention of accidents. In the accident prevention rules of the Rhine Westphalian Engineering and Small Iron Industries Association, I find laid down in the first paragraph:

"The gangways in all workrooms must be broad enough to exclude as far as possible injury to persons using them by machinery or transmission parts in motion. They must be kept in good condition, and must not be blocked by the heaping of material or the transportation of articles."

Exactly the converse condition is what exists in most of our engineering shops. There is no room. The place is congested, and manufactured or half manufactured articles lie promiscuously about in all directions, blocking the passageway. The entire freedom from such disorder in German shops and work-rooms undoubtedly conduces to efficiency as well as to safety, and it is secured chiefly through the habits of order inculcated in all alike—workmen, managers and owners—by

the military discipline they have undergone. Fencing of machinery is required.

With regard to the installation of machinery and workshop appliances, I can only say that the Germans have our best machines installed. They make use of electric power, automatic tools, etc. Of course, there are small shops where one will find two men working on a lathe when it was intended to be run by a single man.

The shops are well provided with sanitary, washing and dressing accommodations. The workmen are clean and careful in their habits. They generally keep a working suit of clothes, and change before and after work. Consequently, lockers are provided. Baths are common, particularly shower baths. The practice of providing comfort and conveniences for workmen by employers is more common in Germany than in America.

The workmen are quiet and particularly intelligent. You might say they are no brighter than American workmen, but they seem to be because they do well what they are told to do. Mechanics working on an engineering order from England do not hesitate to use the original English blueprint with the English measurements. The foreman, on being asked if it would be necessary to turn them into the metric system, said, "Oh, no, the men will work from the English figures all right." Now, would or could our American mechanics do the same? The workmen are not in the least inventive; they never make suggestions as our American workmen are constantly doing, nor is there any system of encouraging them to do so, but they keep the rules and do not strike. In short, they do what they are told, and do it well. Herein is the second cause of the success of the metal industry in Germany.

Roughly speaking, the working hours are ten a day. The following schedule taken from the different metal industries in Germany, will show exactly the length and distribution of the day's work.

Hours in Engineering Works at Düsseldorf

Begin	6:30 A. M.
Breakfast	8:15 to 8:30 A. M.
Dinner	12 to 1:30 P. M.
Tea	4:15 to 4:30 P. M.
Close	6:30 P. M.

Total, 12 hours, minus 2 hours for meals, equals 10 hours, week 60 hours.

Hours in Machinery Works at Düsseldorf

Begin	7 A. M.
Dinner	12 to 1:30 P. M.
Close	6:30 P. M.

Total, 11½ hours, minus 1½ hour for meals, equals 10 hours, week 60 hours.

Hours in Engineering Works at Chemnitz

Begin	6 A. M. (winter 7 A. M.)
Breakfast	8 to 8:30 A. M.
Dinner	12 to 1 P. M.
Tea	4 to 4:15 P. M.
Close	6 P. M. (winter 7 P. M.)

Total, 12 hours minus 1¾ hour for meals, equals 10¼ hours, week 61½ hours.

Hours in Steel Works at Essen (Krupp)

Begin	6 A. M.
Breakfast	8 to 8:15 A. M.
Dinner	12 to 1:30 P. M.
Tea	4 to 4:15 P. M.
Close	6 P. M.

Total, 12 hours, minus 2 hours for meals, equals 10 hours, week 60 hours.

The normal day is ten hours and the normal week is 60 hours. The great difference between the United States and Germany is the number and length of the meal intervals allowed in the latter. As a rule, in the United States the only interval allowed is for dinner and that is generally no more than three-quarters of an hour or half an hour. In some American shops when they are busy no interval is allowed at all; the men snatch their food as best they can. The machinery runs continuously and this is the secret of the great production of the American steel mills in particular and of the excessively high wages earned by them. Deliberateness and respect for meal times is as characteristic of Germans as hurry and indifference to them are of Americans.

BELL FOUNDING IN OLD FRANCE

By JOSEPH G. HORNER*

The accompanying illustrations of bell founding in France show the practice used previous to 1777, when the French encyclopedia, from which these illustrations are taken, was published.

Plate 1 shows in the upper part a bell foundry, with a pit in which the molds are contained, covered with a shed. The furnace, uncovered, is seen to the right. In Fig. 1 a molder is seen applying with his hands the tempered loam to form the model of a bell. He takes the loam from a cask by his side, seen to the right. In Fig. 2 the other workman pushes the loam board (the gage, or pattern) in order to unite or compress the loam, and to remove or scrape off the superfluous material. Fig. 3 shows the core of another bell; the cope is seen suspended by the tackle.

The lower part of this plate, Fig. 1, shows a detail of the

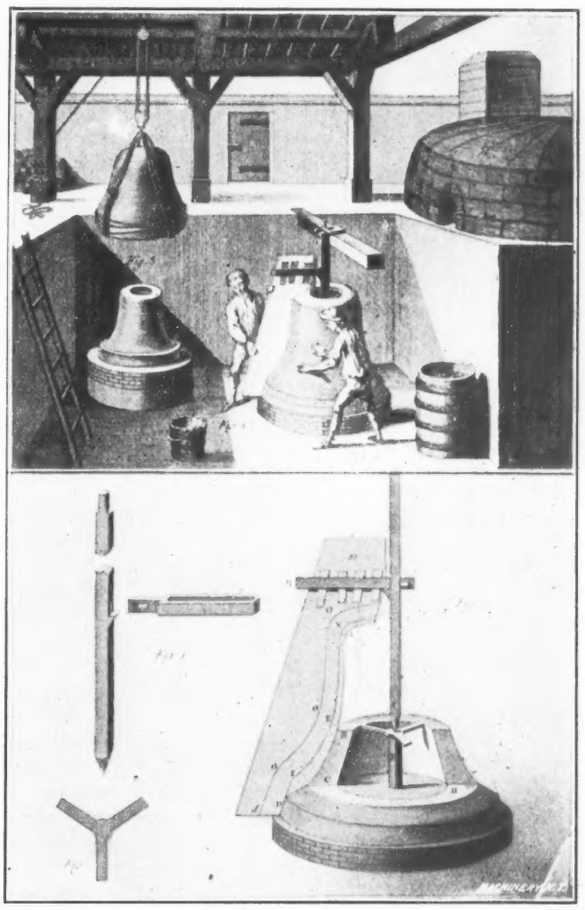


Plate I. Molding Pit and Methods used in a Bell Foundry 150 Years ago

striking bar or "compass" seen in Fig. 2 above, at *G*. Two pieces of iron compose the bar. The vertical arbor terminates at the bottom in a pivot, and at the top by a trunnion, and carries the "strong arm" mortised through it, on which the gage or striking board is fastened. Fig. 2 below shows the socket or step of iron, which is fixed by its three branches in the solid mass of the core, and the center of which carries the pivot of the arbor of the compass or striking bar. Fig. 3 shows the arrangement mounted with the striking board in place. The masonry of the core is broken away to leave visible stake *E* planted in the middle of the mold, on the head of which rests the three-branched footstep which supports the arbor and compass. The board is secured to the arm with wedges. The lines drawn on the board show the thickness of metal, just as the patternmaker puts them on to-day. Outside the metal the outer thickness of the loam cope is also drawn in.

Plate II illustrates the different portions of the mold in detail. The core is shown in Fig. 4. We are told that the edge of the pattern board in the previous plate has been cut

* Address: 45, Sydney Buildings, Bath, England.

with bill-hook and chisel to the form of the interior of the bell, and that the edge has been beveled so that it does not tear up the loam. On commencing to work the core, its mold or body is put together with bricks, partly entire and partly broken, and covered inside and outside by the loam. The exterior angles of the bricks are broken, in order to give the masonry a true circle. As each brick is placed, the striking board is presented for the purpose of setting or correction. At a certain stage of the building up, the wooden peg *E*, Fig. 3 in Plate I, is put in place to afford support to the triangular step,

Plate II. Steps in Making the Core and Mold

the arms of which are laid on the masonry. The work then proceeds to the full height. Then a bush of charcoal is let into the top of the core. All the brickwork is covered with a crust of cement made of clay, horse manure, and hair, well beaten and mixed together on a bench, with the head of a mattock. It is then put on with the hands, and the gage turned. A fire is lit to dry the first coat, which drying occupies from 12 to 24 hours. It is stated that during the drying, the molder must be careful to refresh the water parts of the mold that are dry, because uniformity of drying is necessary and some of the interior parts dry more slowly than others.

Two coats or applications of loam are made, each being dried. The second coat is finer and more liquid than the first. A third coat is then laid on, composed of cinders and soap; this greasy coat makes it easier to detach the mold yet to be built when it has to be lifted off. The final diameters and the circular truth are carefully checked before this last coat is put on, which is not dried. (It might have been a thin application of wax, though the word used is *savon*.) It is a parting thickness, serving the same function as a thick coat of blackwash, to effect a separation between the core and the mold to be built on it.

After the core is thus completed, the model or pattern of the false bell has to be struck. The board is removed from its bar and its edge cut back to the lines representing the pattern body, the edge beveled, and the bar and board replaced in its pivot.

The loam of which the model is formed is stated to be of clay, sieved and mixed with hair and horse manure; this is for the first coat. The workman takes his hands full of this, and applies it on the core in several thin applications which are amalgamated to form the thickness required. Each coat is gaged by the board and is dried by a fire. All these coats are covered with hemp to prevent the mold from cracking and splitting.

When the "false bell mold" or loam is thus finished, bordering lines are marked to indicate the positions for the fillets for the inscriptions, and proportions of the bell. Afterwards follows the building up of the cope or the last part of the mold, to prepare for which a composition of tallow, soap, and wax is used. The striking board is replaced, and a light or thin coat of this composition is swept on by the edge of the board to give an equal thickness. The board is then removed and the inscriptions are put on, and also other relief figures. Then all is ready for making up the cope. It must, according to the description, be extremely strong as it has to endure the heat due to casting, be buried in earth well trampled and beaten down, and carry the whole of the weight and force of the metal at the time of pouring. To strike this, the edge of the board is cut to the outline of the cope, the third line in Fig. 3 of Plate I. The first coat applied is of fine clay passed through the sieve and mixed with hair, horse manure, and water to the consistency of thin mortar. The molder takes the mixture in his hands and applies it softly to the surface of the model so as not to derange the letters and the figures. It covers all the parts in relief, filling and finishing the cavities of the figures and letters. This operation is continued to a certain thickness, which is allowed to dry without fire. It requires about 12 or 15 hours to form a crust. A second

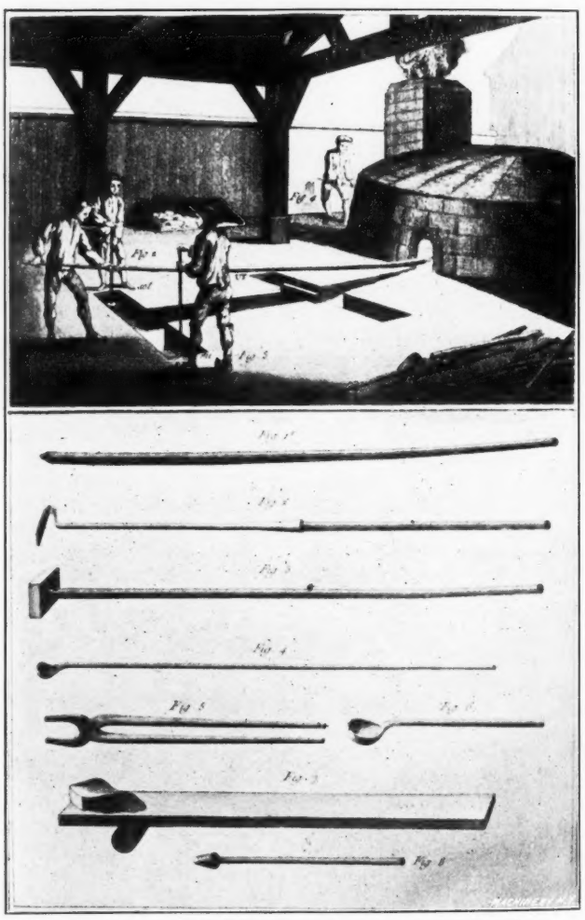


Plate III. Pouring the Metal, and Tools used in Bell Founding

coat of the same material is then laid over this coat, but not so thin, and when this second one has reached a certain consistency, the striking-board is replaced, and a fire put in the core to melt the wax in the inscriptions, and to impart, little by little, in the first coats the hollows of the letters and figures.

The next charge of loam is less thin, and each further application is more and more solid, and between these is placed plenty of hemp. Finally the cope is lifted by the hooks and

rope seen in Fig. 6. Cracks and defects are made good, if present, followed by drying with lighted straw. The model of the bell is broken away from the core, which is cleaned and dried before replacing the cope.

Fig. 7, Plate II, shows the core, which has a ring core for suspending the clapper, rammed in it. The eye is shown separately between Figs. 4 and 5. Fig. 8 is the model of a mold for the figures in wax. It is of copper, and drawn for a double section. It has a double edge that contains the wax which takes easily the imprint of the hollow portion. The letters are molded in the same manner. Fig. 9 shows the imprint in wax drawn from the mold, and in the state in which it is applied on the model of the bell.

Fig. 10 is the covering mold which contains the mold of the horns or handles, the casting, and the vents in the side opposite to the entry of the metal. Fig. 11 is the same taken from the side of the entry of the metal. Fig. 12 is a plan of the horns. Fig. 13 shows them in perspective on the upper part of the bell. These horns are made of loam cakes or cores.

The operation of pouring the metal for the molds is shown in Plate III. The furnace is of the reverberatory type. The fire, of wood, is built on a grating, fired from above, and the ashes are removed from a pit descended to by steps. These are on the other side of the view, out of sight. The master founder is seen in Fig. 1 tapping the furnace with a long pole to run the metal into the molds. He controls the flow by introducing more or less of the rod into the hole in the furnace. The molds are situated at the ends of the cross channels indicated. Two bells at the first cross channel are first cast, and the assistant founders (Figs. 2 and 3) are ready to lift the plugs of iron covered with clay at the set in the second channel as soon as the first two molds are filled. At Fig. 4 the workman pushes the metal with a rabble of wood towards the tapping hole.

When the time for pouring arrives, the canals are cleared and a charcoal fire is kept in them during the time of the melting of the metal. The ends of the rods are also heated. The tools are shown in the lower part of the plate. Of these Fig. 1 is the tapping pole, Fig. 2 is a rabble of iron with a handle of wood for skimming the metal, Fig. 3 is a rabble of wood handled with a rod of the same for pushing the metal towards the opening of the tapping hole when melted, Fig. 4 is a spoon for taking samples of metal, and by them to judge of its condition, Fig. 7 is a charging bar for use at the door of the furnace, and Fig. 8 is a clay plug for the air holes.

* * *

HIGH-PRESSURE CYLINDER DIAMETERS FOR AIR COMPRESSORS*

By J. WILLIAM JONES†

The charts in the accompanying Data Sheet Supplement are intended for rapid determination of the proper diameters of high-pressure cylinders for compound air compressors. By means of these charts it is possible to find instantly the required high-pressure cylinder diameter for various pressures and altitudes, when the low-pressure cylinder diameter is known.

The first of the three charts is laid out for sea level conditions. The diameter and stroke of the low-pressure cylinder are first computed with reference to the required piston displacement, and from this diameter the high-pressure cylinder diameter is traced on the chart as shown by the dotted lines and arrows, which indicate the method of procedure when the diameter of the low-pressure cylinder is 20 inches, and the air compressed to 200 pounds gage pressure. The ratio between the cylinder diameters when found in this manner divides the load equally between the two stages, provided the intercooler abstracts all the heat due to compression in the first stage. The two other charts are laid out for 5000- and 10,000-foot altitudes, but are otherwise used in the same manner as the first chart.

A problem which often confronts the compressor builder when manufacturing a standard line is to obtain cylinder ratios which will be approximately correct for various conditions. As an example, assume that it is required to determine the dimensions for the high-pressure cylinder of a compound compressor having a low-pressure cylinder of 30 inches diameter. It is required to find the correct cylinder ratios for 80 to 100 pounds gage pressures for altitudes from sea level up to 5000 feet. Referring to the sea level chart we find that the proper diameter of the high-pressure cylinder for 80 pounds would be 18⅞ inches, and for 100 pounds, 18 inches. On the 5000-foot altitude chart we find that the high-pressure cylinder at this altitude should be 18⅛ and 17¼ inches, for 80 and 100 pounds pressure, respectively. A convenient mean

TABLE OF ABSOLUTE RATIOS OF COMPRESSION

Gage Pressure, Pounds	Absolute Ratio of Compression		
	Sea Level	5,000 Feet	10,000 Feet
80	6.44	7.55	8.92
100	7.80	9.20	10.90
125	9.50	11.25	13.40
150	11.20	13.30	15.90
200	14.60	17.40	20.80
250	18.00	21.50	25.80
300	21.40	25.60	30.80

of the above pressures would be 18 inches diameter, which would meet the requirements of the case very satisfactorily.

The ratios of the cylinder areas as given on the charts are obtained from the absolute ratio of compression. Assume, for example, that a compression of 150 pounds gage pressure is required. Then the absolute pressure equals 150 + 14.7 = 164.7 pounds, and the absolute ratio of compression is 164.7 ÷ 14.7 = 11.2. The square root of this ratio is the ratio of the low-pressure piston area to the high-pressure piston area, or,

$$\sqrt{11.2} = 3.35 = \text{ratio of cylinder areas.}$$

A table of absolute ratios of compression for various pressures and altitudes is given above.

The general formula for determining the high-pressure cylinder diameter when the low-pressure cylinder diameter, the initial pressure, and the terminal pressure are known, is as follows:

$$d = \sqrt{\frac{D^2}{\sqrt{\frac{P_1 + P_2}{P_1}}}}$$

in which d = diameter of high-pressure cylinder,
D = diameter of low-pressure cylinder,
P_1 = initial pressure,
P_2 = terminal gage pressure.

At sea level, of course, the initial pressure P_1 is the atmospheric pressure or 14.7 pounds per square inch.

As an example, assume that a given compressor requires a low-pressure cylinder of 33 inches diameter. Find the high-pressure cylinder diameter for compressing air to 100 pounds gage pressure at sea level.

$$d = \sqrt{\frac{33^2}{\sqrt{\frac{14.7 + 100}{14.7}}}} = 19.75 \text{ inches.}$$

This calculation, however, is somewhat lengthy, and the accompanying Data Sheet Supplement will be found very convenient, in that it gives the diameter required directly without any calculation whatever.

* * *

Other things being equal, a grinding machine of massive construction can successfully use softer wheels and run at lower speeds than grinding machines of a lighter type. The greater mass of the heavy machine reduces the amplitude of the vibrations and makes the soft wheel work efficiently where a harder wheel would be required on the lighter machine. Lower wheel speeds, of course, means less power and less wear and tear of both the machine and the wheel.

* With Data Sheet Supplement.
† Address: Painted Post, N. Y.

THE CONVERSION OF COMPOUND ENGINEERING UNITS

By JULIAN C. SMALLWOOD

The purpose of this article is to present a simple method by which may be found such metric-English equivalents as are not ordinarily tabulated in hand-books and by the use of which one may conveniently translate the more commonly used compound units. The method may also be used for the conversion of constants in empirical formulas, so that, if given in the metric system, they may be made applicable to English units.

Briefly, this method consists in first writing the units involved in the quantity to be converted exactly as they appear in it, and then canceling them as common factors in the terms of a fraction are canceled. The units that remain are fundamental ones of the system to be translated, whose equivalents may easily be remembered. If these equivalents are substituted in the canceled form, a number results by which the given quantity is multiplied to effect the conversion.

In mechanical and thermodynamic quantities, the fundamental units are those of length, mass, temperature, and time. All compound units of measure in mechanics and thermodynamics are combinations of these. As the unit of mass is but little used in the English system, we may consider, instead, weight which is directly proportional to it. The following are the familiar equivalents of these fundamental units:

Length: 1 centimeter = 0.3937 in. 1 in. = 2.54 centimeter.
Weight: 1 kilogram = 2.205 lb. 1 lb. = 0.4536 kilogram.
Temp.: 1 deg. C. = 1.8 deg. F. 1 deg. F. = 0.556 deg. C.

The data given in either column of this table are all that are necessary to make any conversion. Suppose, as a simple example, that we wish to find the English equivalent of the modulus of elasticity having the metric value of 700,000. This quantity, in English, may be defined as the pressure per square inch divided by its elongation per unit length. Its units may be written:

$$\frac{\text{Pressure per square inch}}{\text{Elongation per inch}} = \frac{\dfrac{\text{pounds}}{\text{inches}^2}}{\dfrac{\text{inches}}{\text{inches}}} = \frac{\text{pounds}}{\text{inches}^2}$$

That is, the units of the quantity "elongation per unit length" cancel each other. Similarly, the French units of the modulus are kilograms per square centimeter.

Substituting in the expression

$$\text{Modulus} = 700{,}000\ \frac{\text{kilograms}}{\text{centimeters}^2}$$

the English equivalents of the kilogram and centimeter, we have

$$\text{Modulus} = 700{,}000 \times \frac{2.205\ \text{pounds}}{0.3937^2\ \text{inches}^2}$$

$$= 10{,}000{,}000 \text{ pounds per square inch, approx.}$$

Let us take as a more obscure quantity, the mechanical equivalent of heat—in English, 778. This is the number of foot-pounds of work equivalent to 1 B. T. U., or, to make the arrangement of the units clearer, foot-pounds of work per B. T. U. It is desired to find how many kilogram-meters there are to a calorie, the calorie being the amount of heat necessary to raise the temperature of one kilogram of water one degree C. As heat is measured by multiplying weight by temperature, the units of the mechanical equivalent of heat may be written:

$$\frac{\text{Units of work}}{\text{Units of heat}} = \frac{\text{feet} \times \text{pounds}}{\text{pounds} \times \text{degrees F.}} = \frac{12 \times \text{inches}}{\text{degrees F.}}$$

The metric value sought may now be obtained by substituting the equivalents of inches and degrees as follows:

$$778 \times \frac{12 \times \text{inches}}{\text{degrees F.}} = \frac{778 \times 12 \times 2.54\ \text{centimeters}}{0.556\ \text{degrees C.} \times 100} = 427$$

meters per degree C. or kilogram-meters per calorie.

This is then the metric value for the mechanical equivalent of heat.

If the units of a quantity to be converted are not readily recognized, they may in some cases be determined by examining those of an identical one. For example, consider the quantity denoted by the symbol R in the equation for perfect gases

$$PV = RT.$$

In this equation P is pressure in pounds per square foot; V is the volume of one pound; and T, temperature. It may be written, to show the units of R, as follows:

$$R = PV \times \frac{1}{T} = \frac{\text{pounds}}{\text{feet}^2} \times \frac{\text{feet}^3}{\text{pounds}} \times \frac{1}{\text{degrees F.}} = \frac{\text{feet}}{\text{degrees F.}}$$

For air, $R = 53.4$, and the metric value is found as follows:

$$53.4 \times \frac{12 \times \text{inches}}{\text{degrees F.}} = 53.4 \times \frac{12 \times 2.54}{0.556 \times 100} = 29.3.$$

The factor 100 is used to change centimeters to meters.

It is in a similar manner that the constants of empirical formulas may be converted. For example, Francis' formula for suppressed weirs is, in English,

$$Q = 3.33\ B\ \sqrt{H^3},$$

in which Q is the discharge in cubic feet per second; B, the breadth of, and H the head on, the weir in feet. The metric coefficient may be ascertained thus:

Units of 3.33 =

$$\text{Units of } \frac{Q}{B\ \sqrt{H^3}} = \frac{\text{feet}^3 \text{ per second}}{\text{feet} \times \sqrt{\text{feet}^3}} = \frac{\sqrt{\text{feet}}}{\text{seconds}}$$

Hence, by multiplying 3.33 by $\sqrt{12 \times 0.0254}$, the metric value, 1.84, of this coefficient is obtained.

Even if the empirical equation to be translated contains more than two compounded quantities, the conversion is in no way complicated. As an illustration, consider the metric relation

$$PV = 47.1\ T - 0.016\ P$$

in which P is the pressure of steam in kilograms per square meter; V, its specific volume in cubic meters per kilogram; and T, temperature, in centigrades. The units of the quantity $47.1\ T$ must be of the same kind as those of PV and of $0.016\ P$, for, if they were not, the quantities could not be added or subtracted as indicated. We, therefore, know that the units of the coefficient, 47.1, are the same as those of $\frac{PV}{T}$, or units of 47.1 =

$$\frac{\text{kilograms}}{\text{meters}^2} \times \frac{\text{meters}^3}{\text{kilograms}} \times \frac{1}{\text{degrees C.}} = \frac{\text{meters}}{\text{degrees C.}}$$

To find the value of the coefficient of T in an English equation using pounds, feet, and degrees F., it is, therefore, necessary to multiply 47.1 by $\frac{39.37}{12} \times \frac{1}{1.8}$; the value 85.85 is thus obtained. Similarly, the units of the coefficient of P are cubic meters per kilogram and its English value is 0.256.

There are some quantities that are misleading in regard to their units. For example, one might consider that the heat of vaporization, heat of the liquid, etc., as given in steam tables are expressed in heat units only. If it is remembered, however, that such a quantity is the number of heat *units to one pound of the material*, or heat units per pound, it will be seen that the unit of temperature is the only one to be considered in making a conversion; that is, the unit of weight in the denominator cancels that in the numerator. If, then, we multiply such a metric quantity by 1.8, the corresponding quantity in an English table will be obtained.

The foregoing examples should enable the reader to apply this method to any metric-English conversion. It is only necessary to add a word of caution that, in using it, *all* the units involved should be put down exactly as they appear in the expression to be converted.

* * *

"The eye of the master will do more than both his hands."—*Poor Richard's Almanack.*

* Address: Chadwick, N. J.

THE EXPERIENCES OF A YOUNG TOOLMAKER*

By T. COVEY

"Jim," said Mr. Corbin, "I want you to help George for a few days. He is building a special tool for putting slots in a taper hole, and will need considerable help. There is also some of the work that you can do."

"All right, sir," said Jim, and he hunted up George and told him that he was to help him on the job.

"Well, said George, "this is quite a big job, and I guess I will let you rough out this operating bar for me. Here is the blueprint of it. You will notice that there is a one-inch hole clear through it. I want you to turn it off, leaving about one-sixteenth inch on it so as to give us a chance to turn it up straight after the hole is bored, and bore the hole.

"The first thing will be to center it and turn some spots for the steadyrest. I think the best way to center it will be to roughly center one end with a breast drill, then put it in that

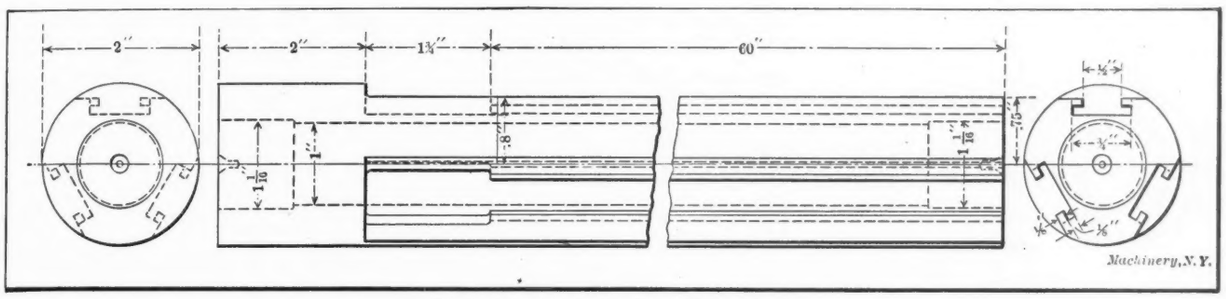


Fig. 1. Operating Bar for Taper Slotting Tool

lathe with the long bed, catch the uncentered end in the chuck and let the other end run on the center. True up the end in the chuck, and turn a spot a couple of inches long close up to the chuck; then turn the bar around and let this spot run in the rest with the other end running true in the chuck; then you can face the end off and center it. Then turn a spot next to the chuck again and turn the bar around, face the end off to length, which will probably take out the old center, and recenter it. It will be well to note if there are any bends in the bar and if so favor them when centering it, but don't try to spring the bar straight. When you get it centered I will show you how to start turning it."

Jim took the blueprint (see Fig. 1) and the stock to his vise and before starting work on it measured the piece of stock. He noticed that there was over one-half inch of stock to come off the diameter. Going over to George, he said: "George, there is over one-half inch of stock on that bar. Why didn't they give us a smaller piece? I think that a piece of 2-inch cold-rolled stock would have made that nicely; then we would not have needed to center it or turn it at all."

"That piece of stock is all right," said George. "It is low-grade annealed tool steel, and when you get it turned, if you have been careful, there will be no strains in it and it will be straight. If it were cold-rolled it would be in the form of an S or a rainbow when you got the hole bored to say nothing of the slots that are to be cut in it. This bar has got to be straight when done or it will be of no use, and as it will then be only a shell it should be of stronger material than cold-rolled machinery steel."

"Why is cold-rolled steel more liable to spring than forged steel or common rolled stock?"

"Well, that is not a hard question to answer. I suppose that the difference is due to the process followed in the manufacture. On bars that are well heated during the rolling or forging the kneading effect of the operations penetrates more deeply, and therefore such severe strains are not given to the metal; and if the bars are afterward annealed such strains as there may be are mostly eliminated. With cold rolling, however, the action necessary to bring the bars to the required shape takes place mostly on the outer surface, and the high places are of course rolled more, or receive more pressure than the low ones, and for this reason, as cold rolling certainly sets up strains in the metal, the effect of the process is to produce an unstable product, the removal of any part of which is liable to affect the remainder. This is proven in practice, as it is well known that scarcely any two pieces of cold-rolled steel act the same under machining operations."

"I don't know much about the stuff, and only suggested it because I thought that it would be much easier to make the bar of it," said Jim as he went back to center the piece, which he soon finished.

"Now," said George, "take off the chuck and put on the driver; put a dog on the bar and place it between centers, then put the steadyrest on as close up to the headstock as you can, so that it will not interfere with the dog; back the jaws of the rest away so that the bar can revolve without touching

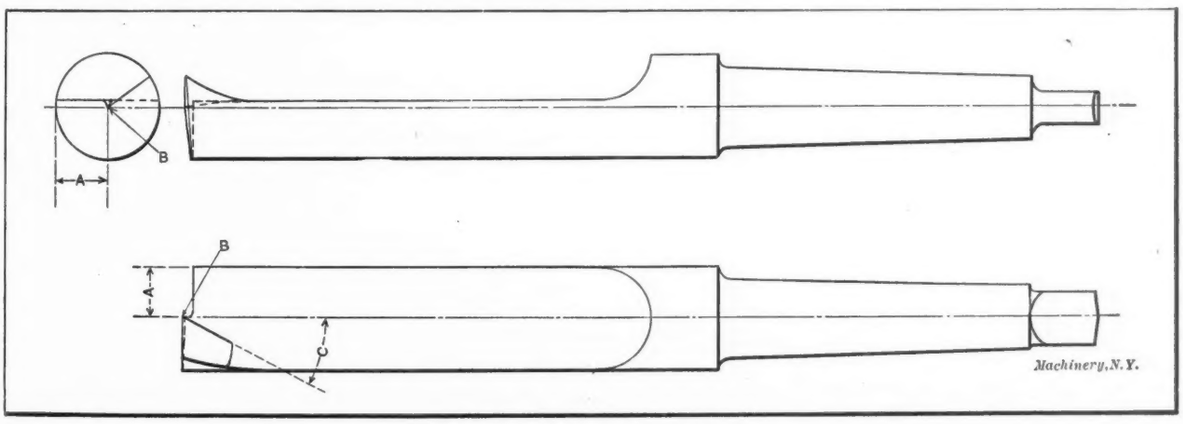


Fig. 2. Hognose Drill of Approved Form

them, then turn a spot eight or ten inches away from the end that has the dog on it and be very careful to get the spot true and round, because if there is any error in the first spot it will not only appear in the next but will be increased. Bring up the steadyrest, close the jaws down on the spot carefully and fasten them, clamping the steadyrest fast to the bed of the lathe; now if the bar is stiff enough, turn a spot a little to one side of the center toward the headstock end. If the bar chatters too much, you will have to turn one about half way between this place and the spot that is running in the rest; then move the rest to that and turn the spot near the center and move the rest to that. You can then go ahead and take a heavy cut from half the bar, removing about two-thirds of

* For previous installments of this series of articles, see "Experiences of a Young Toolmaker," with accompanying references, June, 1910.

the stock; then turn a smooth spot about four or five inches from where the cut stops, turn the bar around and rough off the other end, letting the spot last turned run in the rest. Now if you back the jaws of the rest away and start the lathe you will probably find that the bar is crooked, but as most of the strains have been removed with the outer surface the chances are that if you repeat the spotting process, beginning at the headstock end as before, and take another cut over the bar, you will then find it comparatively straight."

Jim went ahead and in the course of the day had the bar turned up, leaving about a sixteenth inch of stock on it to finish. Then he called George to look it over and tell him what to do next. George backed the steadyrest jaws away, and, revolving the bar rapidly, he found that it was pretty straight and told Jim he had done a good job so far.

"The next thing," said George, "is to get that hole in it. It is only put there to lighten the bar so it does not have to be so very accurate; still it must be straight enough to leave the walls fairly equal. I think that if we bore from both ends we will get it good enough. I am quite sure that there is a ⅞ extension shank about three feet long for drills with No. 2 Morse shanks in the toolroom, but if there is not we will have to make one. See if you can get one, and also a ¾-inch twist drill and a 1-inch hognose drill."

Jim found that there was an extension and brought it with the drills to the lathe. George looked them over and said: "We had best drive each drill into the socket and drill and ream a small hole through the socket and the shank of each drill so that we can pin it fast in the socket while we are using it, for if we should get one of the drills stuck down in the hole we might have quite a bit of trouble in getting it out; there is not much danger if the drills are kept sharp but it is best not to take any chances. Now find a piece of steel about 1⅛-inch diameter by about 3 inches long, catch one end of it in the lathe chuck and bore it out ¾ inch diameter for about an inch, turn it for the same distance to a diameter of about two or three thousandths less than one inch, and cut it off with a parting tool, thus making a collar one inch in diameter and one inch long with a ¾-inch hole."

Jim soon got the collar made and George told him to put one end of the bar in the chuck and run the other in the steadyrest, and to be very careful to have the end in the chuck running true and the steadyrest set up so as to bring the bar in line with the tailstock center, for on this depends the accuracy of the hole to a certain extent. "Let me look at it before you start boring," said George.

In a short time Jim had the bar chucked up and called George to look at it. George tried the chuck end and found it true, then he cleaned out the center in the other end put a little prussian blue on the center in the tailstock and carefully ran it into the center in the bar; then he backed it out looked at it and said: "It is just a little low but pretty good"; he raised it a little, tried it again and then told Jim to go ahead and put the twist drill in to about the depth of the flutes. Jim did this and then went to George and said: "I don't see how we can get that ¾-inch drill through the bar with that ⅞ extension on it."

"That is easy," said George. "Drill in as far as you have gone with the twist drill with the hognose, then you can put the ¾-drill in again and go four or five inches more, etc. Now to start a hognose drill properly you have to do one of two things—either start it through a bushing or bore the hole out for a short distance just the size of the drill. You can't use a bushing in this case, so you will have to bore the hole out for an inch or so with a boring tool. Be very careful to have the hole just the size of the drill for if it is either large or small the drill will not work good.

"A hognose drill to work right must be kept in good condition, and not be allowed to get dull or out of shape. It is a very easy matter to spoil one in grinding. The main thing to be careful of is not to grind away the center. That portion of the drill marked *A*, Fig. 2, should be ground back about three-thirty-seconds inch on this size of drill, and the wheel used should have a rounded corner. The lip is ground with a wheel having a rather square corner, and the edge of the lip leads away from the center at about the angle *C*. This is done so that sharpening the drill on the end will allow the center of the drill to come within the metal; then using a depth gage with the scale set to just half the diameter of the drill, grind the portion *A* and the lip of the drill so that the point *B* comes just in the center of the drill. The center is found by holding the depth gage against the sides of the drill with the end of the scale that is set to half the diameter pointing towards the center. You will notice that that portion of the drill cut away in making it is a little less than half of the drill; that is, it is not cut down to the center line; this shape combined with the radius at the center edge of the portion *A*, and the angle of the edge of the lip *C*, enables a new center to be obtained by grinding off the end. The inner end of the cutting edge *B* must be in the center because if it is too short or too low the drill would leave a core when drilling in solid metal, and if too long or too high would have no clearance at the center. It is best to have the cutting edge a very little short or low than long or high, as it is theoretically impossible to give the cutting edge of a hognose drill clearance at the center, but in practice they work very good with the inner end of the cutting edge central."

"Now each time that you follow up the twist drill with the hognose run the hognose in far enough to remove all the center left by the point of the twist drill, and then to start the twist drill central again clean out the hole either with the air blast, or with a piece of waste fastened to the end of a small rod, slip the collar you made down into the bottom of the hole using a rod to push it down into place. This collar will act as a bushing to steady the twist drill in starting. When you have the drill started you can pull it out with a rod that has a small hook bent on the end of it. In this manner you can prevent the twist drill from running off center, as it cannot run very far in five or six inches and the bushing will restart it central."

"How can I tell when I have run the hognose drill in far enough to take out all of the hole made by the twist drill?" asked Jim.

"You can see for the first time or so, or at any time with the aid of a small mirror; after the first time you will probably be able to tell from the way the drill feeds whether it is cutting in solid metal or not."

"If the hognose drill will cut to center, as you say it will if ground right, why use the twist drill at all?"

"This extension might not be strong enough to carry the full cut; and then the hognose working under the strain of a full cut would bear against the side opposite the cutting edge so hard that there would be great danger of the drill "picking up" and starting to cut or score, which would spoil the drill and make a bad hole. If you could keep the drill well flooded with oil you might do it, but I would not risk it. Keep plenty of oil in the hole anyway; get one of those squirt-guns out of the toolroom and use it often. Put a pan under the lathe where it will catch the oil and keep it off the floor; you can also fill the squirt-gun from it. Clean the chips out of the hole often, and don't allow them to pack tight at any time. If you are careful otherwise I think when you have the hole completed you will be unable to see where the holes meet in the center."

Jim found it a rather tedious job but in the course of a couple of days had the hole bored through. Taking the bar out of the lathe and looking through the hole, he found, as George had said, that he was unable to tell where the two cuts came together. He had George look at it and George said that it looked fine and told him to get a one-inch plug sizer; they tried it in the hole and found that it was an easy fit with no shape. George pushed it in as far as he could with his fingers and then taking a piece of cold-rolled stock that was lying near pushed the plug clear through the hole, finding a spot in the center where it was tight but still it would go through.

"Well, Jim," said he, "you have learned how to bore a long, straight hole. If you ever have a similar job to do again pin your faith to a hognose drill. It will do a good job if it is well ground and treated right. Now put the bar back in the lathe, bore out the ends to 1 1/16 inch and plug them up; then set up the bar and center again, which will be about all you can do with it."

MACHINE SHOP PRACTICE*

KEY FITTING

The proper method of fitting a key in its seat depends somewhat on the type of key used, which is governed largely by the class of work for which it is intended. In Fig. 1 several methods of securing a shaft and hub against relative rotary movements by the use of keys are indicated. The style illustrated at *A* is known as a "saddle key." This type, which is shown in perspective at *A*, Fig. 2, has parallel sides and is curved on its under side to fit the shaft. It is slightly tapered on top so that when it is driven tightly in place, the shaft is held by frictional resistance. This key should be fitted so that it bears lightly on the sides and heavily between the shaft and

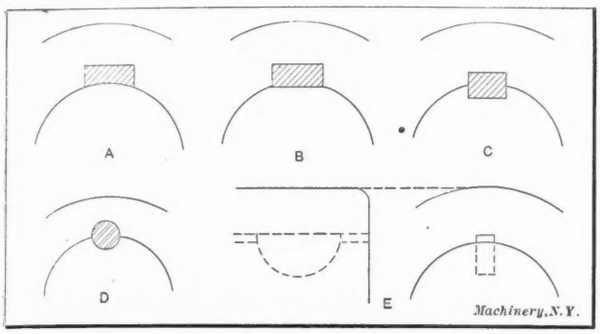


Fig. 1. Various Methods of Keying Shafts and Hubs

hub throughout its entire length. As the drive with this type of key is not positive, it is only used where there is little power to transmit. Of course, it is an inexpensive method of keying, as the shaft does not need to be machined.

The "flat key" shown at *B* differs from the saddle key in that it bears against a flat surface on the shaft, which gives it a fairly good grip. This type is not adapted to heavy work, however, owing to the excessive strains to which the hub is subjected, as the shaft tends to turn. The method of fitting is practically the same as for the saddle key, there being a comparatively light bearing at the sides and a heavy bearing at the top and bottom. The "sunk key" shown at *C*, as its name implies, is sunk into the shaft, and it is more satisfactory than either of the other types referred to, as it gives a stronger and more positive drive. With this type of key, care should be taken to secure a good bearing on the sides. Ordinarily the bearing at the top and bottom of a sunk key should be comparatively light, though in some cases when it is used to resist endwise movement, as well as a rotary movement, it is given a heavy bearing on all sides. The principal bearing, however, should not be, in any case, at the top and

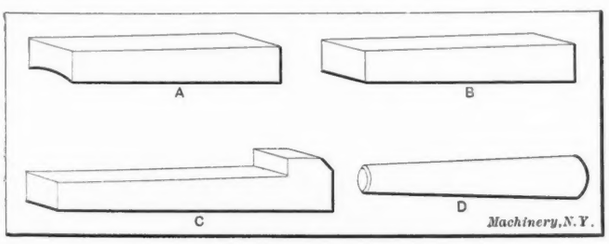


Fig. 2. Different Types of Keys

bottom, as it is then more likely to work loose than when fitted tightly at the sides.

Keys are usually milled or planed slightly larger than their keyseats, so that they may be accurately fitted by filing. After a key has been reduced sufficiently to allow it to enter the keyseat, it is driven in as far as it will go by tapping lightly; it is then removed and the bearing marks filed away. This operation is repeated until the key can be driven home.

When a key is so located that it can be removed by driving against the inner end with a punch, the headless type shown at *B*, Fig. 2, is generally used. Very often, however, it is impossible to drive against the inner end; in that case the style of key illustrated at *C* is preferable, as the head enables it to be withdrawn when fitting or disassembling, by the use of a wedge or lever. The style of punch shown in Fig. 3 will be found excellent for driving out headless keys. Before driving a key into its seat, it should be oiled to facilitate its removal. It is also a good plan before driving a key in for the purpose of testing its bearing, to round the corners so that they will not interfere by bearing heavily on small fillets which may have been left in the keyseats. By covering the keyseat with a thin coat of black or red lead, the bearing can be more easily seen.

As the accuracy with which a sunk key can be fitted depends largely on the relative positions and sizes of the keyseats in the shaft and hub, it is, of course, essential that the keyseating be carefully done. Each keyway, in addition to being of the same width, should be in line with the axis of the shaft or bore and the sides should be parallel with a radial line passing through the keyway center. Obviously, when the keyseats of both shaft and hub are cut in this way, the sides, when the two are brought together, will line up both across and lengthwise of the shaft, making it possible to give the key a good bearing.

The Woodruff key, which is much used in machine tool construction, is in the form of a half-disk as shown at *E*, Fig. 1. The circular side of this key is seated in a slot which is milled to the same radius in the shaft, thus making it necessary to assemble both shaft and hub with the key in place. Little hand-fitting is necessary with this type of key. The bearing should be on the sides, and the top should be

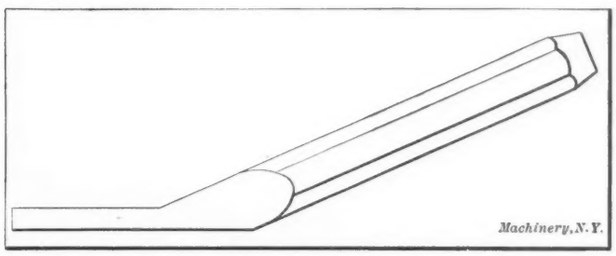


Fig. 3. Punch for Backing Out Headless Keys

filed until it has a light bearing as with the sunk, rectangular key.

Taper pins, similar to the one shown at *D* in Fig. 2, are sometimes used as keys for attaching handwheels to their shafts, and for other similar light work which requires an inexpensive method. The hole for the key is drilled partly in the shaft and partly in the hub, as shown at *D* in Fig. 1, so that the pin, when in place, resists any relative movement between the two. After a straight hole has been drilled, the pin is fitted by reaming the hole with a taper reamer.

* * *

THE PERILS OF AVIATION

Navigating the air is a glorious but dangerous sport. The New York *World* has compiled a list of twelve aviators killed within the past two years, as follows:

1908

September 17—Lieut. Thomas E. Selfridge, U. S. A., fell with Orville Wright at Fort Myer, near Washington, D. C.

1909

September 7—E. Lefebvre fell in Wright machine at Juvisy-sur-Orge, France.

September 7—Ena Rossi killed in Rome in machine of his own invention.

September 22—Capt. Louis F. Ferber fell at Boulogne, France.

December 6—Antonio Fernandez fell 1000 feet at Nice, France, after motor exploded.

1910

January 4—Leon Delagrange fell at Bordeaux, France.

April 2—Herbert Le Blon instantly killed, falling on rocks at San Sebastian, Spain.

May 13—Chauvette Michelin fell at Lyons, France.

June 17—Eugene Speyer fell at San Francisco.

June 18—Robl fell at Stettin, Germany.

July 3—Charles Wachter fell at Rheims, France, in Antoinette monoplane after its wire stays broke.

July 12—Charles Stewart Rolls fell at Bournemouth, England, in French-built Wright machine after the forward directing plane broke under strain of too rapid descent.

* With Shop Operation Sheet Supplement.

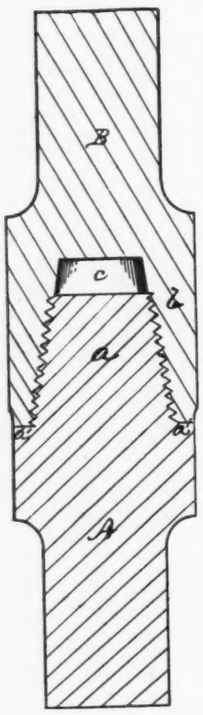
MACHINE WORK IN THE OIL COUNTRY—MAKING "JOINTS"

By V. J. M.

In the last fifty years a great many changes and improvements have been made in the method of drilling wells for oil, gas or water, and a comparison of the tools used by Col. Drake (who drilled the first well for oil in 1859 at Pit Hole, near Titusville, Pa.) with a modern outfit would cause one to think that Col. Drake surely had the right variety of "sand" to tackle such a job and bring it to a successful consummation.

Since that time the search for the green, brown or black fluid has spread to almost every civilized country on the globe. Several different methods of drilling are in use at present, but what is known as the cable system is the most common. In this system manila rope was used exclusively, but wire rope has recently been found useful for sand lines, although, as yet, it has not proved very successful for drilling. One of the prime reasons for this no doubt lies in the fact that the wire lacks the necessary spring or stretch as well as flexibility.

A common "string" of drilling tools consists of the various sizes of drills or bits, the auger stem, jars and rope socket.



To all whom it may concern:

Be it known that I, JOHN LYON ALEXANDER, of Edenburg, in the county of Clarion and State of Pennsylvania, have invented a new and useful Improvement in Joints for Oil-Well Tools, &c.; and I do hereby declare the following to be a full, clear, and exact description thereof, reference being given to the accompanying drawing, forming part of this specification, and which is a longitudinal central section of a joint embodying my invention.

My invention relates to the construction of joints for oil-well tools; and consists in tapering the pin and interior of the box, and also tapering the threaded pin, so that their strength is greatly augmented at and near the shoulders, where they are subjected to the greatest strain, and are most liable to break.

Heretofore, in the construction of joints for oil-well tools, sucker-rods, &c., it has been common to form an internally-threaded socket or box of even bore (or interior diameter) throughout, and whose thickness was about one-fourth the diameter of the joint, so that the whole amount of metal was about equally divided between the box and pin.

When in use, the greatest strain occurs either at the top or shoulder of the box, or at the shoulder of the pin, and the joint frequently breaks either at one point or the other, causing much trouble and delay.

It is at once apparent that the strength of the ordinary joint is only equal to the strength of the pin or of a rod one-half the diameter of said joint, and thus in such connections the points where the greatest strains occur are in reality the least able to resist them. It is not possible to overcome this difficulty by increasing the thickness of the box and pin, for such a procedure would increase the diameter of the joint beyond what it is practicable to use in an oil or similar well.

In order that others skilled in the art to which it appertains may apply my invention, I will proceed to describe the construction of joint whereby I overcome the existing difficulties and objections.

A and B indicate the two sections of a joint with threaded pin *a* and socket or box *b*. The pin *a*, at its base, is slightly less in diameter than the whole diameter of the joint, and tapers thence to its extremity, which may be half the diameter of the joint, or less, if desired, or, in other words, is a frustum of a cone whose base is slightly less than a cross-section of the joint.

The difference between the diameter of the pin at its base and the whole diameter of the joint is due to a slight shoulder, *a'*, against which the socket *b* abuts.

b is the socket or box section, having the tapered cavity *c*, corresponding to the form of pin *a*, so that the thickness of the box or socket increases steadily from its extremity toward the shoulder, and at the shoulder it is almost solid, whereby great strength is gained.

The pin *a* and box *b* are threaded, as before specified.

In connecting the parts much time is saved and less labor required, as the pin passes about half-way into the box or socket before the threads engage, and the parts being centered, there is no difficulty or delay in causing the threads to engage properly.

The diameters of the pin and box at the shoulders being equal, or about equal, to the whole diameter of the joint, great strength is obtained; and if, from leverage or other cause, the upper part of pin *a* should be broken in the socket or box, the parts would not separate unless the force were sufficient to break the box also, which is very unlikely to occur, as the box at that point would be very thick.

Additional advantages of my devices are, that they can be screwed up or set much tighter than any other joint known to me, and this without danger of breaking. Longer and heavier wrenches may be used to tighten the parts, and the parts are more readily handled and connected.

I am aware that tapering sectional joints have heretofore been made, and do not claim the same, as such construction is directed sim-

Fig. 1. Specification of Alexander Patent No. 201,082 for Improved Joint for Oil-well Drills

These separate parts are well connected by threaded joints for convenience in handling, and as the bits wear out of gage they are taken off, heated, dressed and hardened. This operation occurs quite often, the frequency with which

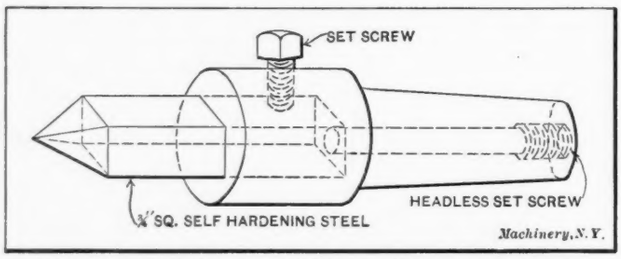


Fig. 3. Square Center used in Tailstock of Lathe for Center Work

the bits require dressing depending largely upon the character of the rock being drilled. Formerly the joints were made with a straight screw thread, but the taper joint has come into extensive use and the straight screw joints have been almost entirely discarded. It was in 1878 that patent No. 201,082 (see Fig 1) was issued to John L. Alexander of Edenburg, Pa., for a taper joint for oil well tools. The model for his invention was made by James Sheridan of Franklin, Pa. It may be of interest to machinists who are working on this class of work to know that these first taper joints were made without a lathe taper attachment, the tools being fed in and out by hand.

The principal advantages of the taper over the straight

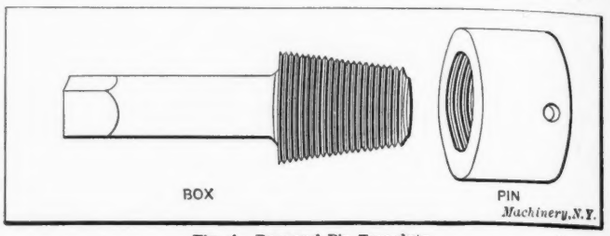


Fig. 4. Box and Pin Templets

joint are as follows: 1. Reinforcement or added strength at the weakest points (see Fig. 2). 2. Convenience in putting together as well as time saved in so doing. With the old style straight joints it was quite difficult to enter or start the thread, while with the taper joints it is a "cinch." From

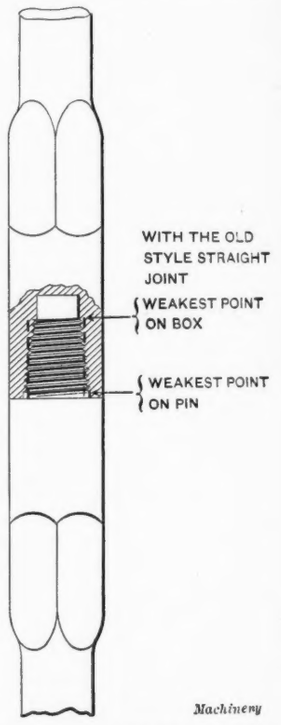


Fig. 2. Alexander's Taper Joint and the Straight Joint Compared

four to five turns are all that is required to bring the threads fully into mesh. 3. Renewal is made possible by facing back on the collars, taking the same amount off the end of the pin and re-threading. In the old style straight "joints" when the threads became worn or stripped the only way possible to renew them was to heat the box and swage. This practice had the disadvantage that the box, if worn much, would be too small in diameter after swaging. The pin had to be heated and upset in order to give enough stock. This often caused a cold-shut at the base, and the least sign of cross fracture condemns the piece unless the crack can be entirely removed in turning.

The material used in box and pin forgings is either soft steel of about twenty-six points carbon or faggoted iron, iron being preferred for the joints on the auger stem, because it withstands the jar and vibration better than steel. The box on an auger stem gets more use and abuse than the pin on the bit, especially as there is always one bit held in reserve, and all the different sized bits are used in the same box. The weight of the stem as well as the force of the blow comes upon the faces or shoulder at every stroke, and soft steel joints, especially on the lower end of the stem, upset too easily and in

consequence cause many "fishing" jobs. But for all the upper joints, such as the jar box and pin and those on the rope socket, soft steel cannot be surpassed, either in price, ease of machining or strength. The iron mostly used is old car axles, doubled over, piled up to get the proper amount, thoroughly welded and forged.

In making the forgings for boxes and pins, the blacksmith is never very particular as to size, excepting about 6 inches of the shank which is forged square to fit the standard size of wrenches. Plenty of stock is left on the collars.

When starting to machine the pin, the joint turner selects a forging with the proper sized square, say 3½ inches, puts a trial center in the pin end and grips the shank end with the chuck; then, by chipping, square centering (see Fig. 3) and

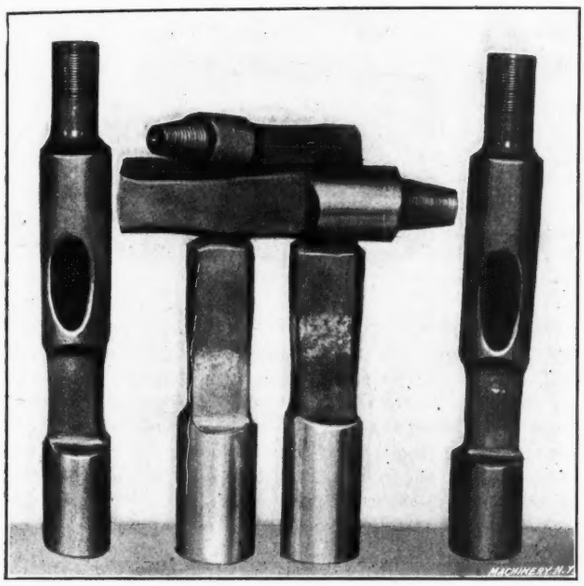


Fig. 5. Box, Pins and Rope Sockets

shifting in the chuck, he makes it run true with the wrench squares. Next the collar is turned to size by one roughing cut followed by a scrape with a broad-nosed tool, producing what is known in the oil country as the "Pittsburg finish." The collars are all made to some standard size, depending on the diameter of the hole to be drilled. Care in this respect is necessary so that in case a joint unscrews or for any other reason a part is lost in the well, the proper "fishing" tool may be "run" to remove it. The careful driller always keeps a record of the size of each joint and tool that goes into the well—and the writer has heard of some drillers who go so far as to bid the tools good-by each time they are lowered for fear they may never see them again.

The next operation is to rough down the pin nearly to size at the large end and square up the shoulder to give the pin the proper length, say 4 inches. A broad square-nosed tool is then used to bring the pin to the proper size at the large

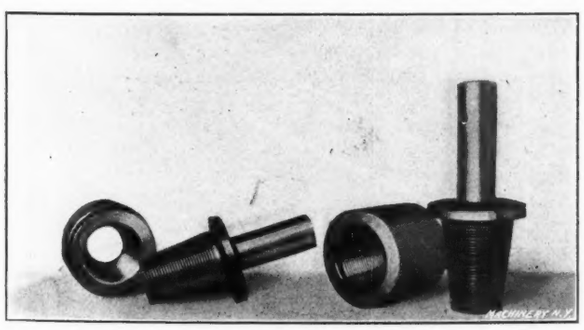


Fig. 6. Improved Templets with Collars on Pins

end, as this is the point where measurements are taken from. The taper attachment is then brought into use and the pin turned to the proper size for threading. Tapers vary from 3 to 3½ inches, and over, per foot, or from 7 to 10 degrees measured from the center line. The Gleason and Bridgeford lathes have the taper attachments graded according to a system of their own, the graduations corresponding to the taper per foot, in eighths of an inch. Thus 3 inches per foot is marked 24, which means 24/8, and 3 7/16 inches, per foot is marked 27½, which means $\frac{27\frac{1}{2}}{8}$. It is hardly necessary to say that in taper turning this, as well as any other kind, the

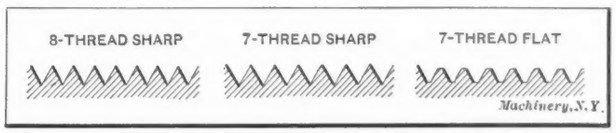


Fig. 7. Forms of Screw Thread Used on Oil-well Tools

point of the tool should be set level with the center line.

The thread is cut with a 60-degree angle, single-point tool. Many patent tool-holders work fairly well, but a solid tool forged from good high-speed steel gives the best results. The thread is cut as close up to the shoulder as possible in order that the box need not be counterbored more than ½ inch. It is good practice to use two threading tools, the first having its top face ground like a side tool, taking all the chips from the left-hand side, and being advanced for each cut by the compound rest set at 15 degrees; the second tool should be made with very little top rake and plenty of clearance on the bottom so that each side of the thread can be finished separately. There is a curious prejudice as to the lubricant for cutting threads on joints; while the drillers are not all Prohibitionists by any means, they all prefer their threads finished with a water cut. A superstition seems to prevail that lard

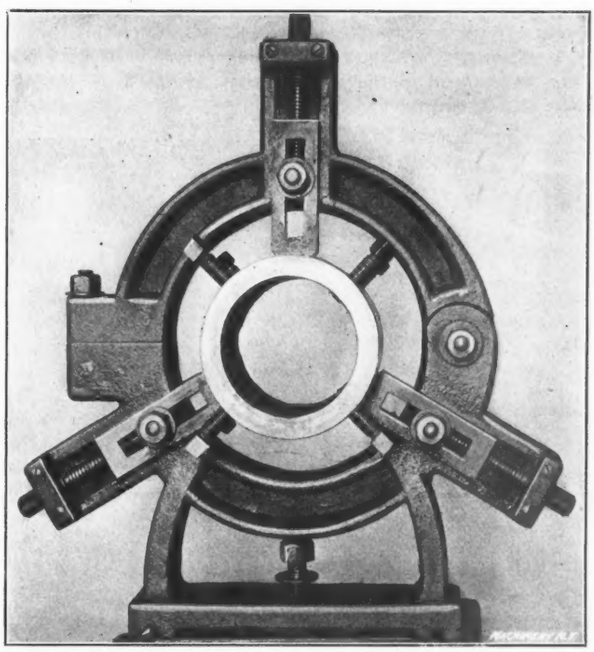


Fig. 8. Lathe Steadyrest with "Cat-head" or Revolving Ring

oil used when cutting the threads will make them unscrew unless burnt off.

After the thread has been finished, the gage or templet is screwed on, and the collar faced back to admit a finger or paddle gage between the two faces, thus bringing all the pins to the size of the gages. The gages (see Figs. 4 and 6) are made of iron or soft steel and need not be hardened. They are real boxes or pins, excepting that the boxes are shorter on the face end by ½, ⅝ or ¾ inch to suit the practice of any particular shop, and the pins have the collars cut back a like amount. When the pin templet is made without a collar it goes into the box flush and is tested by a straightedge.

After the ring gage is removed from the pin a slight clearance or undercut is made in the collar next to the pin. This is done on the same principle that a carpenter, in laying flooring, undercuts his joints in order that they may fit closely

on the top, but the main reason is that when in use in the field the faces on the joint collars undergo a great deal of scouring to keep them clean, and by having this sharp corner removed it is easier to keep the faces level and thus avoid unscrewing.

The pin is now brought to length by paring off the small end with a side tool set at an angle of about 10 degrees, which completes the job with the exception of stamping the size on the collar. A stamp thus: $2\frac{1}{4} \times 3\frac{1}{4}$ M 7 means $2\frac{1}{4}$ inches diameter at the small end, $3\frac{1}{4}$ inches diameter at the large

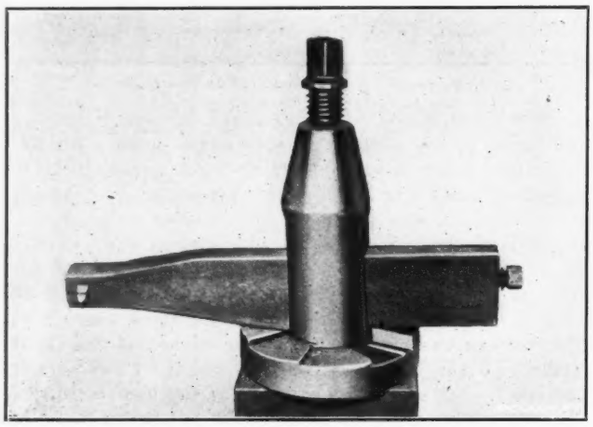


Fig. 9. Inside Thread Tool used for Drilling Boxes

end and 7 threads per inch. The M denotes this particular make, in this case known as the "Maloney." One hour is a fair average for the time taken to turn this pin. The pins on bits are turned in the same manner, excepting that a "cat-head" or a revolving ring in a steadyrest is used in centering, as the end of the pin can then be faced off and the center drilled and reamed. (See Fig. 8.) When the bits are made of tool steel throughout and the pins not perfectly annealed, this is a good method of getting a "loud" center—one that will hold up until the job is finished. If any one thing more than another tends to provoke an outburst of profanity it is to have a bit get tired of its small stingy center and go floating off into space when nearly completed.

The box is centered in the same manner as the pin and turned to size. The steadyrest is then placed near the middle of the round portion, the end faced off and a hole drilled the same size as the bottom of the threads on the small end of the pin and at least $1\frac{1}{4}$ inch deeper than the length of the pin. A very good tool for this purpose is a flat drill with the cutting edges lipped and the point ground heart-shaped. When made of high-speed steel this drill can be rapidly fed into iron or soft steel, making a $2\frac{1}{4}$-inch hole 6 inches deep, in 5 minutes. A set of jaws of hard brass for the steadyrest will last a year and will not mar the finished work. For boring the taper in the box, any good stiff tool will do, the size of hole being taken from a gage made to fit in on top of the threads in the ring templet. These are made of sheet steel 1/16 inch thick, with a scribe line, showing the depth to which it must enter when the box will be the proper size.

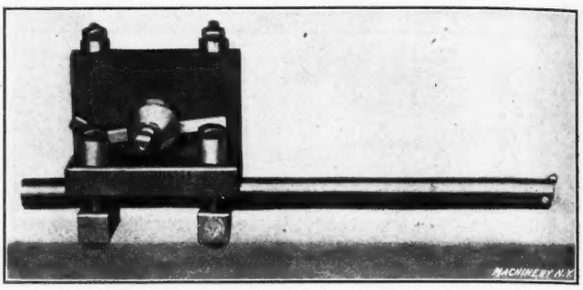


Fig. 10. Boring Tool used for Boring Taper Holes such as Tapers for Rope Knot in "Woodpecker" Sockets

For threading tools, one with an inserted cutter is best adapted for inside work; the cutters can be made of small square steel, no dressing being required. Care should be taken to have plenty of clearance so that the heel of the tool will not drag in the small end of the hole. The writer has used, for the last ten years, a tool made as shown in Fig. 9. The body is made of $\frac{7}{8} \times 2$ inch annealed steel with a hole to fit $\frac{3}{8}$-inch square steel; the top face is on the center line and $\frac{1}{4}$ inch

Fig. 11. Typical View of Work around "Joint Lathe" in Oil Country Shop

stock in front. A 13/32-inch hole is drilled from the back end to intersect the square hole and a piece of ⅜-inch drill rod put in for a plunger with a ½-inch set-screw behind it. This holder need not be loosened in the tool-post; simply slacken the set-screw to remove the cutter for sharpening. A boring tool for deeper holes is shown in Fig. 10.

When the thread in the box is finished, the chips are removed by spinning the lathe backwards and holding a stick of wood on top of the threads—which as the "cub" says "unscrews the chips." The gage is then screwed in and the box faced to size, care being taken to have the box bored large enough to let the plug gage enter far enough to leave stock on the face for this purpose. When the gage is taken out, the large end of the box is counterbored, removing three or four of the first threads. This is done because it is not

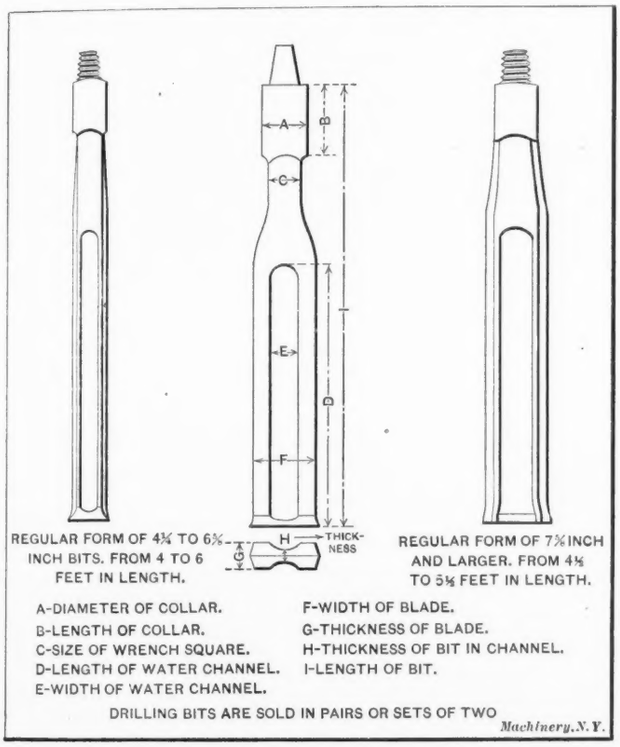


Fig. 12. Forms and Parts of Oil-well Drill Bits

possible to thread the pin clear into the collar. The corner of the box is chamfered off so that the face will correspond in size to that on the collar of the pin which fits it. After stamping, the box is complete, the time required being from 1½ to 2 hours. There is no allowance made for force fit; a good joint should have a slight shake just before shouldering, for, if made tight on the threads, when the shoulders become worn the threads get so tight that the pin is often twisted off.

* * *

VALUE OF ADVERTISING

The value of an advertisement in a trade journal or any other advertising medium, is determined *not* merely by the number of answers you receive, but by the number of actual sales resulting therefrom. There are third- and fourth-rate journals that can safely promise you hundreds or even thousands of answers to any advertisement that they may print—but what are the answers? They are on postal cards and scraps of paper, some of them so poorly written as to be absolutely undecipherable, all asking you for your catalogue and prices, but how often do such inquiries result in sales? On the other hand, an advertisement in the right kind of a trade journal may result in only ten answers, but they come in typewritten form, on firm's letterheads and are signed by someone with authority to buy and in eight cases out of ten who *does* buy, for the original inquiry was not prompted by mere boyish curiosity, but because the things advertised were needed.

It is the old, old question as to whether you prefer quantity or quality.

SOME KINKS FOR PUNCH AND DIE WORK*

By C. W. G.

Before taking up the following suggestions for tool and die makers I would like to call the reader's attention to the fact that in order to acquire as much knowledge of his chosen craft as possible in the least time, he must read the journals devoted to his craft and especially those articles written by "the boys," who are actively engaged in the work. We may not find all articles literary gems, but the writer has yet to read a single article by one of "the boys" without adding some valuable information to his mental capacity or indexed notebook.

Just imagine the value each issue of MACHINERY is to both the young and the experienced toolmaker. How many years would the reader work at the trade before he found out by personal experience that this or that was the best way in which to successfully complete a particular job? On the other hand, let us follow a "roamer" or as they are called in the trade a "hobo" toolmaker. His restless disposition will not allow him to stay long in any one shop, but the few months of experience in each shop has given him the opportunity to grasp the valuable kinks, accurate methods, etc., that have taken men in that shop probably thirty years to discover. Say that this "roamer" lands in a toolroom that is devoted exclusively, and has been for the past forty years, to the most intricate class of die work, while he has just left a job where jigs were the specialty. In a few days he notices that the methods employed there are really valuable and that it never once entered his mind before that this or that clever scheme could be adopted. In a way he is a robber. Without spending more than a few days he is in possession of the valuable experience which it has taken other men a lifetime to collect. By means of a few rough sketches and an earnest attempt at a description his discovery, coupled with editorial touches, makes an article presentable from a literary point of view, and *the valuable idea* is sent broadcast. The following schemes and kinks, or whatever they may rightly be termed have been gathered here and there around the country by the writer, and while some of them are not new to all readers, it may be possible that some readers have not heard of them.

Proper Clearance Between Punch and Die

First we take up the clearance to be given the blanking die. It is a known fact that there is a happy medium where the fit of a punch and die governs their clean cutting. A loose fitting punch will cut absolutely free from burrs up to a certain point, but a little too loose or a little too tight results in ragged edges being left on the punchings. Experienced tool- and die-makers who have spent years in fitting punches can tell mentally just about how much to allow between the punch and die, providing, of course, that they have given them the thickness of the metal to be punched. But the young fellows do not care to wait until they are nearing the end of their usefulness before they are able to tell by personal experience. Therefore, the results obtained by the pioneers have been carefully recorded and information given for clean cutting on all thicknesses of stock. The general rule is to allow a clearance between the punch and die of 6 per cent of the thickness of the stock to be cut. For example, suppose that we desire to punch plain washers 0.040 inch thick. Then six per cent of that equals $0.040 \times 0.06 = 0.0024$ inch which would be the difference between the size of the punch and the die.

The above practice is in vogue in such reputable factories as the Burroughs Adding Machine Co., Detroit, Mich., and has been used by the writer with excellent results. There are many readers who are using this rule, but to those who know it now for the first time, I would advise that they make a mental note that this issue of MACHINERY has been the means of eliminating the worry on their next punch and die in regard to how much clearance to give. Of course, the temper of the stock to be punched enters somewhat into the above calculation, but not enough to make an appreciable difference.

Value of Annealing

Knocking around the country, the writer has noted that the majority of die- and tool-makers overlook the importance of

* For information previously published on punch and die work, see "Operation and Construction of the Sub-Press Die," MACHINERY, July, 1910, and articles there referred to.

first roughing the die nearly to size and then carefully annealing it. There are internal strains set up in the bar of steel during its manufacture which are sure to cause distortion of the die or tool unless these strains are removed before the work is brought to its finished size. Some steel may be found free from strains, but we have no way in which we can tell beforehand whether the steel has "settled" or not. Therefore, to guard against distortion, the careful toolmaker will not take chances, but will anneal the piece after it has been roughed out. Annealing allows the molecules, as it were, to twist and squirm, which seems to relieve these internal strains.

Some years ago the writer made the following test, which settled in his mind the value of annealing before finishing. Four pieces of tool steel were cut from the same bar and the same amount of stock was removed from each piece, finishing them all over to exactly the same dimensions. They were then marked *A*, *B*, *C*, and *D*. Pieces *A* and *B* were annealed after roughing, but *C* and *D* were machined to size. The pyrometer was used to insure heating all the pieces to the same degree, that is 1400 degrees F. The bath was clean water brought to a temperature of 68 degrees F. The pieces were heated individually in a muffle furnace and were allowed to remain in the bath exactly the same length of time (one minute). It should be remembered that it is poor practice, in fact disastrous, to allow dies, especially those having delicate parts, to become chilled in the the bath, as this results in unequal contraction which is the greatest cause of breakages. Leaving the pieces in the bath one minute enabled me to obtain a comparative test, as all conditions were parallel. The pieces *A* and *B* were slightly distorted, but the pieces *C* and *D* were distorted to such an extent that they were useless.

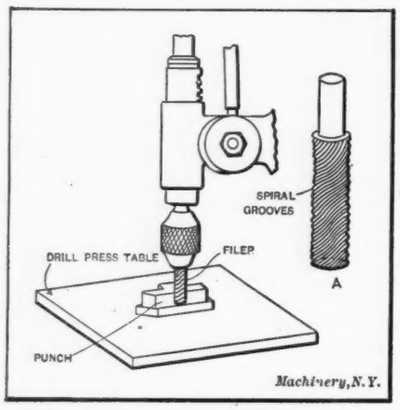


Fig. 1. Filing a Punch to the Finish Line

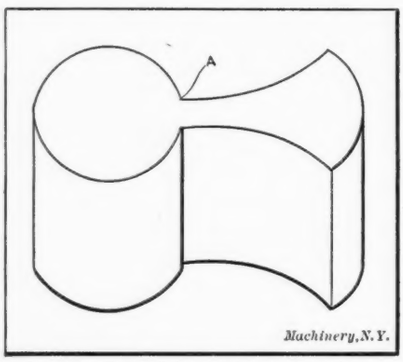


Fig. 2. Difficult Piece to harden without Cracking

How to Lay Out a Die

Another thing which the writer noted along this line, and some day expects to make a test to discover if possible just how much effect it has, is that the best results have always been obtained when long points were laid out lengthwise, that is in the same way in which the grain runs in the stock. It has been noted that dies having several long points which run lengthwise do not distort much in hardening, but that those which are laid off crosswise generally bend to a greater extent. We know in making flat springs that if we cut them out running lengthwise with the grain they will stand up much longer than if we cut them out running across the grain. From my own experience I would suggest to the young toolmaker that he lay out his die with the long projecting points running lengthwise of the grain.

Fitting Punches

Before transferring the outline of an intricate shaped die to the punch, it is good practice to coat the face of the blanking punch with solder. Then machine the solder so that it is level. Coating the punch with solder enables one to obtain a much better outline than would be possible when scribing on the hard steel, and the very narrow and intricate parts can be laid out more easily. Another feature of the solder face is that if there are weak projections it eliminates the chance of breaking them when shearing the punch through the die. If 1/16 inch of solder is evenly placed on the punch, it allows the die to cut a perfect impression in the solder, which is a great help in milling the punch, as the milling cutter can be brought down until it just scrapes the solder, and the cut taken. At the completion of the milling operation the solder is removed, when the punches can be nicely fitted by using the filer shown at *A*, Fig. 1. This filer is made similar to a spiral mill and is placed in the chuck of a drill press, as shown. It cuts remarkably fast, and also leaves a good finish on the punch.

Hardening Dies

There are more cranks on the subject of hardening than on any other subject I can recall. We each have our own pet theory and the writer will put forth his argument which is the result of years of successful hardening of steel that ought to bear out his theory. Let us assume that we are about to harden the piece shown in Fig. 2. This shape is selected to enable us to more clearly describe the theory. Steel expands about ⅛ inch per foot when at a bright heat, but for argument let us assume that the piece to be hardened expands ⅛ inch at 1000 degrees F. Then if the piece be heated quickly, the smaller portion will heat more rapidly and will be brought to 1000 degrees F. while the remaining portion will not be up to that point. Say that the remaining portion will be only 500 degrees F. Therefore, one half has expanded at the rate of ⅛ inch per foot while the other half has expanded only at the rate of 1/16 inch. There must be, of necessity, a weakening effect at the separating line *A*, caused by the unequal expansion. Granting that when heating, it will expand unequally, the reverse action will take place when we immerse it in the bath. That is, the small part will contract quicker than the larger one. Then as the heavier portion continues to contract, there must be a strain at the point separating the two parts which invariably results in a crack at the point *A*. This piece could be successfully hardened by removing it from the bath while it is "sizzling." This allows the heat from the heavier part to run out into the lighter, equalizing the heat, which removes the strain. It also causes the contraction to be more even. Some may say that to remove the piece while it is sizzling would draw the temper, but water will sizzle on steel when the temperature is a little over 200 degrees F., which is not high enough to noticeably affect the hardness of the steel.

Some toolmakers know from experience just when to remove the piece from the bath by the peculiar "singing" noise of the tongs which is familiar to most of them. Others judge from the size of the piece just about how long to leave it in the bath. But the tongs may not feel like "singing," and the bath may be cooler than imagined; the piece larger than estimated or a little hotter due to reflected sunlight, all of which tend to make the foregoing method a matter of guesswork. The best way is to place the hand in the bath alongside of the piece and remove the die just as soon as the fingers can remain on the die without "sticking" to it. Whether this theory is correct or not, it is a fact that those who will try hardening in this way will find that their hardening troubles are over.

* * *

The electrical manufacturing industries in Germany appear, from the annual statements for the business year 1908-1909, to be in a prosperous condition. The Siemens-Schuckert Co., which operates with a total capital of about $26,000,000, declared a dividend of 10 per cent on its capital, and the Siemens & Halske Co., which operates with a total capital of about $22,000,000, declared a dividend of 12 per cent.

* * *

"As keen as a razor" means something so sharp that it will cut a hair supported at one end, but what is the thickness of a keen razor's edge? It is claimed to be only 1/600,000 inch by a manufacturer advertising safety razors. It would be interesting to know how the thickness of edge was accurately measured.

LETTERS ON PRACTICAL SUBJECTS

We pay only for articles published exclusively in MACHINERY

MAKING GEAR CUTTERS FOR A JOBBING SHOP

In reply to the question of R. G. D. published in the July number of MACHINERY, the writer would say that while situated in Melbourne, Australia, he made cutters which were used for automobile work in the following manner:

Starting with a broken spur gear *A*, which generally has two or more of its teeth in good condition, turn a tool steel plug to fit the space between the teeth, as shown at *B* in Fig. 1. After having turned, filed and polished this plug to shape, one-half is cut away as shown at *C* in Fig. 1. This plug is then used as a cutter. Using the toolholder shown in Fig. 2, and setting this up in the planer, it is possible to cut a forming tool to the desired shape. The forming tool is held on an angle plate, as shown in Fig. 2, which has its face set off at an angle of 20 degrees. The cutter is also held in the holder at a corresponding angle, this giving a clearance of 20 degrees on the forming tool. The point of application of the cutting tool is set beyond the center of the clapper-box pin so that the tool will spring away from the work and not dig into it. The angle plate is fastened to the planer bed as shown, care being taken to have the face *A* at right angles to the direction of stroke of the planer, or in other words, at right angles to the planer bed. The forming tool is roughed out to nearly the exact shape and clamped to this angle plate as shown. A hand-wheel for operating the planer table is used for taking the finishing cut. Turpentine will be found to be the best lubricant. After this forming tool is finished it is

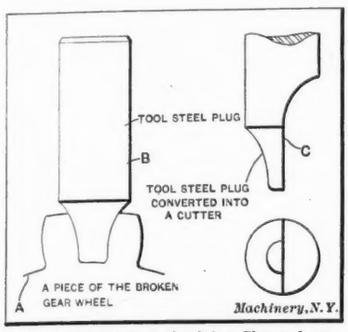


Fig. 1. Method of obtaining Shape from Gear Teeth for Forming Tool

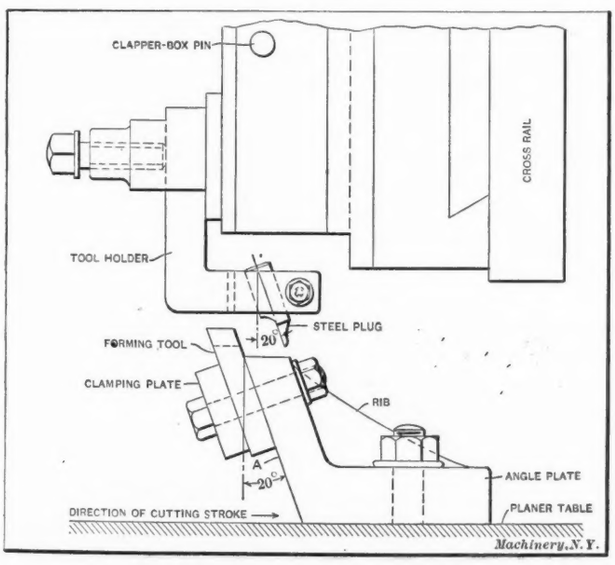


Fig. 2. Making Forming Tool on the Planer

hardened and used in the lathe for forming the milling cutter. The milling cutter is then backed off with this same forming tool.

In Fig. 3 are shown the details of the relieving attachment as used for backing off the milling cutter. *B* is a piece of cold rolled stock having its centers eccentric as shown, and having a piece *A* of machine steel pinned to it by a taper pin. A 1/2-inch hole is tapped into *A* for holding a handle which is used for operating this attachment. *C* is a tool-steel sleeve on which the milling cutter is held while being relieved. A series of 1/4-inch holes are drilled in this piece, the number depending on the number of teeth in the milling cutter. *E* is a nut for holding the milling cutter on the part *C*, and *D* is a nut for holding the part *C* on the arbor *B*. The way in which this backing-off attachment is operated is as follows:

After the cutter blank has been turned to the desired shape it is placed on the sleeve *C*, the 5/32-inch keyway fitting the keyway in the cutter and preventing it from turning while backing off. The nut *E* is then screwed on, holding the milling cutter tightly in place against the face of the sleeve *C*. The part *C* is then slipped over the arbor *B* and the pin *F* inserted in the hole shown in the part *A*, thus locating the part *C* in the desired position relative to the centers in the arbor. The nut *D* is then screwed onto the part *B* holding the face *b* of the part *C* tight up against the face *a* of the part *A*. The backing off is done by pulling the handle (not shown) which is screwed into the half-inch tapped hole. After one tooth has been backed off the nut *D* is released and the pin *F* pulled out and inserted in the following hole in the part *C*.

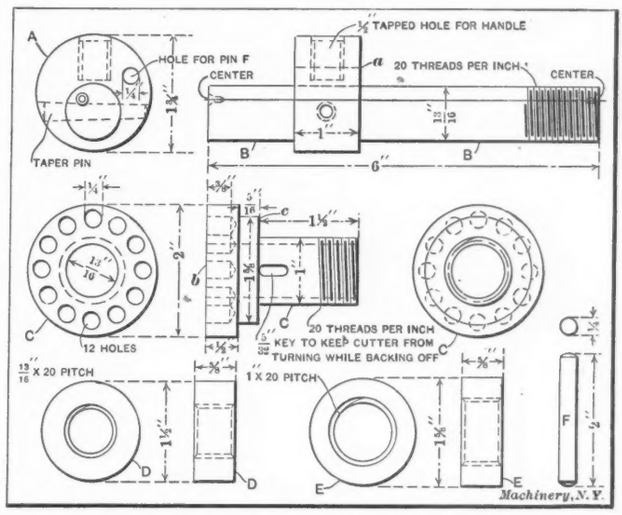


Fig. 3. Details of Backing-off Attachment used in the Lathe

The nut is again tightened and the method as previously explained followed until all the teeth have been backed off. This attachment does not give a true radial curve, but it has been found close enough in most cases, the writer having used this attachment for backing off milling cutters having a face 1 inch wide.

In the case of bevel gears, I made the diameter of the plug two-thirds the width of the widest space between the teeth, or in other words, the width of the space between the teeth at the pitch circle of the gear. After the plug had been cut away as shown at *C* in Fig. 1 it was hardened and drawn, and used as a cutter for making the forming tool as previously explained regarding the making of the forming tool for spur gears.

JACK FINLAY

Hartford, Conn.

HEAT TREATMENT OF STEEL

When, in making a die, I pick out a bar of Jessop steel that is machined only with considerable difficulty, especially in drilling, I know that the bar has not been properly annealed, but I go ahead with the hope that the die may be finished without the necessity of re-annealing. When finished and taken to the fire for hardening, I first heat the die to a cherry red and allow it to cool in the air. Then I am sure it will harden properly in the last heating. In other words, whenever I find a die will not harden, I know that the steel has not been properly annealed at the steel plant and that one good remedy is to heat the steel and allow it to cool in the air before heating for hardening. It is not necessary to anneal it in an annealing pot.

The following experiment bearing on "burnt" steel is in-

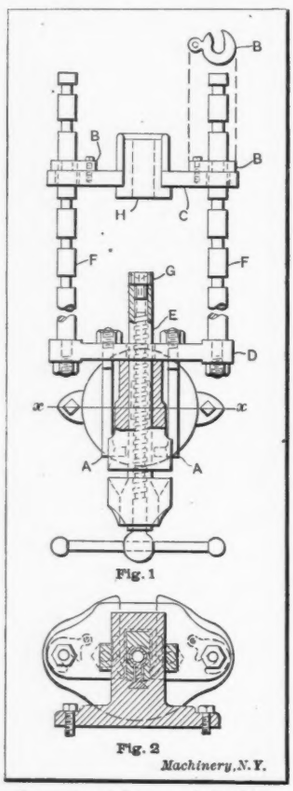
teresting: Place the end of a bar of tool steel about ⅜ inch square in the forge and "burn" about two inches—in fact melt the extreme end—then nick it so that it will break easily near the end. Allow the piece to cool in the air. After cooling, re-heat the bar to a cherry red and harden. Break off the end and you will find the steel is not burnt at all, but has just the same grain as before, due to the heat treatment. In my opinion there is really no such thing as "burning the carbon out of steel."

CHARLES WESLOW

Buffalo, N. Y.

PRESS ATTACHMENT FOR A VISE

The accompanying engraving shows a vise attachment, the object of which is to enable the leverage of the vise to be used for pressing in lathe arbors, bushings, etc. There is sufficient leverage in the ordinary machinist's vise for this purpose, but the opening between the jaws is too narrow. It will be understood from the illustration that the attachment does not (except during the intervals when it is used as a press) materially interfere with the ordinary use of the vise.



Press for Arbors and Bushings which may be attached to an Ordinary Bench Vise

The attachment, a plan view of which is shown in Fig. 1, is secured to a common vise by two bolts *A*, which have L-shaped heads adapted to grip the fixed member of the vise under the jaw.

The clamp or sustaining plate *D*, in which the two bolts *A* are located, is slotted to permit the guide-bar *E* of the outer vise-jaw to pass through it. Secured to *D* are two grooved rods *F* carrying the thrust-plate *C*. The latter has drilled holes at each end large enough to admit of its being moved to different positions along the rods *F*. *C* is held in any required position by the engagement of the hinged latches *B* with the grooves in the rods *F*. While pressing an arbor into the work, one end of the arbor is centered in the conically-recessed plug *G* which fits into the end of the guide-bar *E*, the work into which the arbor has been entered being held against the thrust-plate. Some machinists might prefer to make the plug *G* with a flat end, to prevent cramping the arbor; but by careful manipulation of the work against the thrust-plate, no cramping will occur. The bushing *H*, which is shown inserted in the thrust-plate, is designed for use when handling small work.

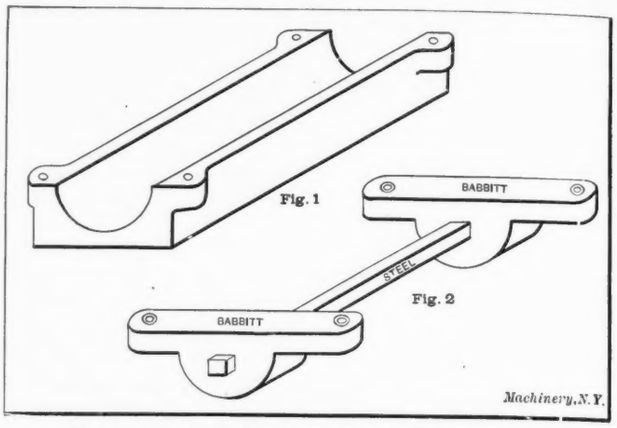
This attachment is best adapted to the wants of those who need a small press occasionally, but who do not feel justified in purchasing a regular arbor press. The distance between the rods *F* may ordinarily be made sufficient for most of the work of a small press. If this distance should be greatly increased, the vise would need to be blocked up, or an opening through the top of the vise-bench would be required to clear work of large diameter.

W. S. LEONARD

Atlanta, Ga.

SIMPLE METHOD OF MAKING A DRILL JIG

A simple and effective jig which was made by a method that is doubtless capable of many applications, is shown in the engraving, which also illustrates the work for which the jig was intended. This jig was used by a metal-pattern maker for drilling the pin holes in a metal core-box (Fig. 1) which were required to be interchangeable. One box was laid out and drilled and pins inserted in the holes. Stock bushings were then placed over these pins, and after closing the ends of the boxes so as to form pockets of the required shape at each end, babbitt was poured in, thus securing the bushings and forming the jig shown in Fig. 2. To obtain



Figs. 1 and 2. Metal Core-box and Jig for Drilling Pin Holes

the proper distance between the bushings lengthwise, a square steel rod was placed through the center.

Of course, this jig would not suffice for accurate work or for continuous use, but the method of making it could doubtless be applied to advantage for certain classes of work. The cheapness and ease with which the jig can be made, is the commendable feature.

D. O. BARRETT

Freeport, Ill.

PUNCH AND DIE FOR PIERCING ANGULAR STOCK

It is a difficult proposition to pierce holes in angular stock which has been previously formed, without distorting it in any way and especially if the holes come close to the edge of the stock. A spring stripper is sometimes used for this purpose, but it is not always satisfactory. In Fig. 1 is shown a side elevation of a punch and die for piercing the angular stock shown in Fig. 2. This punch and die is used for punching both the holes and the slots, the blank being pushed

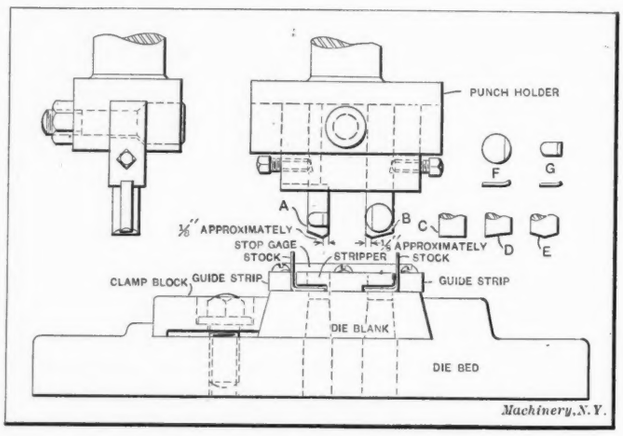


Fig. 1. Details of Punch and Die for Piercing Angular Stock

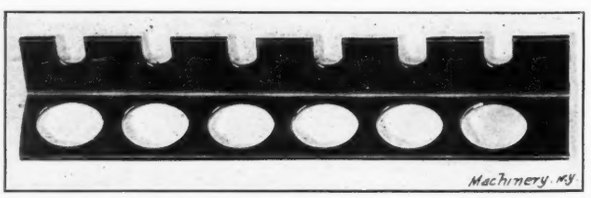


Fig. 2. View showing the Condition of the Angular Strip after Piercing

through on one side of the die and then reversed and pushed through the opposite side, thus punching both the holes and the slots. The punches shown at *A* and *B* were found to give perfect satisfaction. The action of these punches is as follows: When the punch descends onto the stock, it gath-

ers the stock to the center as would occur when drawing a cup. This obviates the stretching of the material around the hole which would occur if the holes were pierced with punches such as shown at *C*, *D* and *E*. The shape of the blanks as formed by the punches *A* and *B* is shown at *F* and *G*. The other details of this punch and die are as ordinarily used and will therefore not require description. A stop gage is used which is operated by hand, thus spacing the holes at equal distances.

CHARLES WESLOW

Buffalo, N. Y.

CONDENSED PRICE LEAF FOR MACHINERY HOUSES

We show herewith a No. 6 modern price leaf with illustration and full description of a line of punch presses that we expect to handle. This price leaf is one of the cleverest ideas that we have ever seen adapted for the use of salesmen,

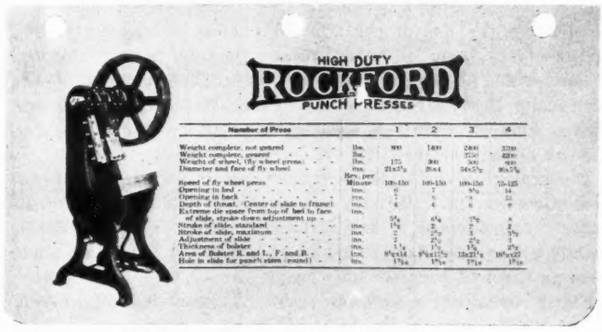


Fig. 1. Condensed Price Leaf for Salesmen

either in the store or on the road. We think it could be profitably adopted by quite a number of machine-tool and

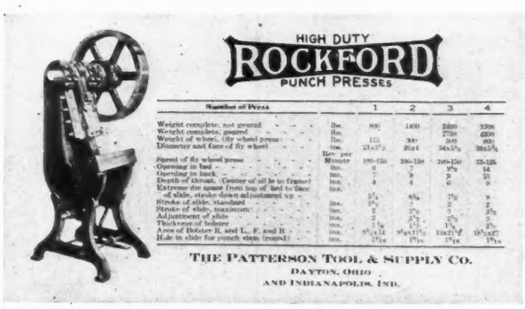


Fig. 2. Condensed Price Card for Mailing

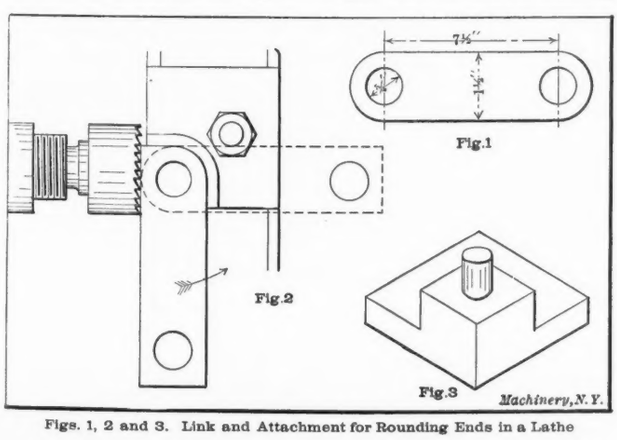
small-tool builders. The same electrotype could be used for printing cards for mailing purposes, and we show a sample herewith in Fig. 2. Both the price leaf and card were gotten up at our suggestion.

THE PATTERSON TOOL & SUPPLY CO.,

Dayton, Ohio. W. B. Patterson, President

ATTACHMENT FOR ROUNDING LINK ENDS

One of our constantly-recurring jobs was rounding the ends of the links shown in Fig. 1. These were of drawn steel ½ inch thick, and as they were called for in lots of from 2 to 40 at a time, the task of "knocking off" the corners in the shaper and finishing on a grinder was more or less laborious; neither was the finished piece always symmetrical. Something had to be done to put this work on a manufacturing basis both as to time and cost, and how this was done is shown in Figs. 2 and 3. A casting (Fig. 3) was made and fitted with a pin the size of the link holes. This block was then bolted to the lathe toolpost and an end mill fitted to a shank in the lathe spindle, which completed the outfit. Now after the links were cut off, drilled and reamed, they were slipped over the pin and given a quarter turn in a horizontal plane. A piece of pipe 18 inches long served to give the necessary leverage. In Fig. 2 may be seen a link, one corner of which has already been rounded, in position for operating on the second corner. The dotted lines indicate its position when one end has been finished.



Figs. 1, 2 and 3. Link and Attachment for Rounding Ends in a Lathe

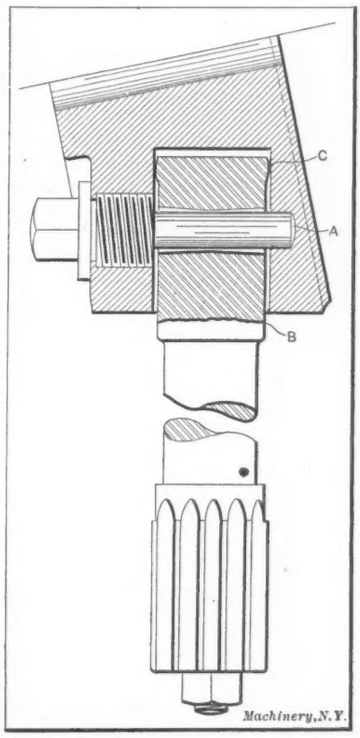
This attachment was ridiculously cheap and so simple that a boy could round 50 links an hour and obtain a finish fully up to the requirements.

DONALD A. HAMPSON

Middletown, N. Y.

FLOATING REAMER FOR INSURING STRAIGHT HOLES

The turret-head on a boring mill had become worn a little so as to throw it out of line, which caused the reamer to cut the holes cone-shaped; that is, they were larger at the top than at the bottom. The machine was used mostly for pulleys and couplings and the holes had to be straight and true with the turned part. This defect was overcome with very little expense and loss of time in the following manner:



Method of Holding a Reamer in a Turret so that it will follow the Bored Hole

First the turret head was removed from the machine and a threaded bushing having a ¾-inch hole was fitted to the screw hole. The reamer shanks were each placed in a hole in the turret and a ¾-inch hole was drilled through each shank and in the turret to a depth of 1 inch. The holes in the reamer shanks were then re-drilled 1/16 inch larger and taper reamed from each end, as shown in the accompanying engraving, which is a sectional view of one hole in the turret to which all the reamer shanks were fitted. The ends *B* of the shanks were then turned 1/16 inch smaller than the turret hole diameter to within ½ inch of the end. The end *C* was next turned spherical in shape, the diameter of the sphere being the same as the hole in the turret, so as to give a bearing on the end, and at the same time allow full play. A screw *A* was then made with a pilot pin ¾ inch in diameter. As will be seen, this screws fits the tightening screw hole and the back part of turret, but it is a loose fit in the reamer shank.

We have had no more trouble from large holes, the holes now being straight and to size. Before using, all the reamer shanks were tested to see that they had a free movement in every direction, because, if from some cause the holes are not drilled true and the reamer will not "float," a taper hole will result.

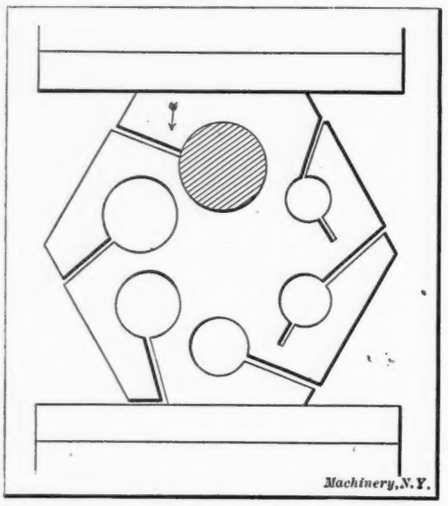
This method of holding a reamer can be applied with equal success to all forms of machines that finish holes with a

reamer, such as turret and engine lathes and drill presses that have become worn and are not true. JOHN BRANDLE

Jackson, Tenn.

A SPRING VISE-CLAMP

When finished or polished rods, spindles, tubes, etc., have to be held in the bench-vise, it is not always judicious to use ordinary flat clamps, because these do not afford a good grip, and in the case of thin pipes, they are likely to squeeze the



Spring Block for Holding Round Work in the Vise

metal out of shape. Some form of split block is better, in which the work rests in a bored hole and is gripped by the elasticity of the metal, the block being split so that the pressure of the jaws closes it in slightly. Some blocks are made of oblong form, with a series of holes and a longitudinal saw-cut to allow of the necessary elasticity. The illustration shows a neat form of block which is more compact than the oblong type. There are six holes of standard sizes, such as 1 inch, 7/8 inch, 3/4 inch, etc., and the block is hexagon in shape, and about an inch in thickness. The holes and the saw cuts are so arranged that the effect of squeezing the block in the jaws, is to close in the holes on opposite sides, thus clamping any work that may be put in them. The block is therefore turned around to suit the particular size of hole that is wanted. The same kind of block might be made octagonal in form and have eight holes, but I have not attempted to devise anything beyond the hexagon, as it seems better to have another block for the next range of sizes. FRED HORNER

Bath, Eng.

HARDENING HIGH-SPEED STEEL

There have been a number of articles reproduced in MACHINERY from time to time on methods of hardening high-speed steel, but I have never seen published the formula here given, which I have used for three years with good results. It is a well-known fact that high-speed steel made up into small and delicate tools such as taps, cutters, etc., should not be blistered or pitted, as this would spoil the cutting edges. It is generally a problem to harden high-speed steel successfully where the necessary equipment, the chloride barium bath, is not available. One of the principal precautions necessary, in hardening high-speed steel, to prevent blistering, is to keep it from the air while the steel is hot. A powder which is composed of corn meal, salt, and prussiate of potash mixed in equal parts has been found a very satisfactory composition. To harden the piece, heat it to a dull red and lay it in the powder. Then return the piece to the fire and heat to a bright red. Dip again in the powder and return once more to the fire and heat to almost a yellow color. Then quench the piece or pieces in cotton-seed or linseed oil. Pieces hardened in this powder will be found free from pitting and scaling and the sharp edges will be maintained. It will be noted that the hardening heat is a great deal lower than that recommended by the makers of various high-speed steels. W. C. BETZ

New Britain, Conn.

AUXILIARY SCALES ON THE TRIANGLE

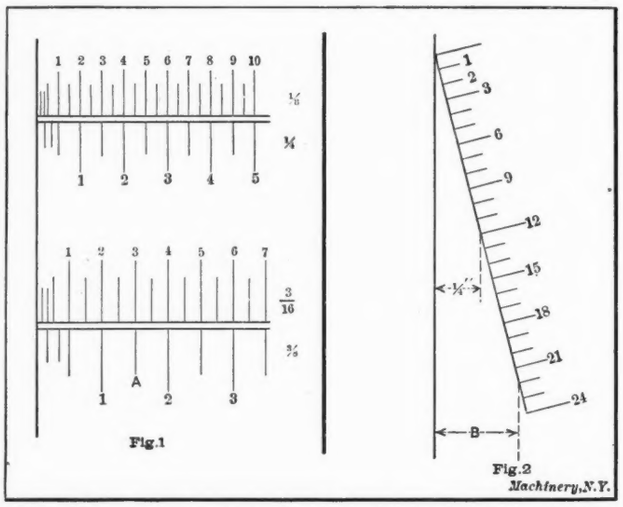
When working on small-scale drawings in which much detail is to be shown, such as the drawings of pipe connections, valves, fittings, etc., the auxiliary scales described in the following will be found of great convenience:

Fig. 1 represents a portion of a celluloid triangle with four scales lined on it. These are reproduced from those upon a draftsman's scale being 1/8, 1/4, 3/16, and 3/8 inch to one foot, respectively. The lines are made by scratching the triangle with a fine prick-point. After this is done, a little india ink rubbed over the marked surface will make the scales more visible. The triangle should then have the figures scratched upon the reverse surface.

To illustrate the use of the instrument, suppose it is desired to draw a vertical line 18 inches to the left of a center-line, to a 3/8-inch scale. The division marked *A* is placed over the center-line and the desired line is then ruled in. That is, the desired line is drawn without other measurement than that involved in the use of the triangle. Thus is accomplished a saving of the labor of removing the triangle for the purpose of measurement with a separate scale, the marking of the position of the desired line, and the replacing of the triangle that it may be drawn—a saving that will be found considerable on certain classes of work.

The scales on the triangle may readily be applied in a vertical direction if it is used in conjunction with another triangle. The surface of the triangle marked with the scales should always be placed next to the drawing paper, as otherwise an error of parallax may result.

Fig. 2 represents a different way of graduating the triangle, by which finer graduations may be made with less care in laying them out. The scale shown consists of twenty-four equal divisions and it is located so that the division 12 is 1/4



Figs. 1 and 2. Auxiliary Scales for Drawing the Details of Small-scale Drawings

inch from the edge of the triangle and the zero division at its edge. With this arrangement a 1/4-inch scale is obtained. It will be seen that the edge of the triangle is 22 inches, to this scale, from the line *B*. This illustrates its application in use.

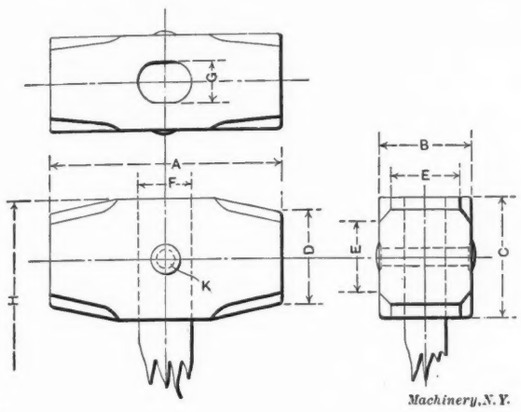
If desired, the lined scale may be made on a thin piece of celluloid instead of on the triangle. It may then be used for a variety of scales by simply changing its inclination to the edge of the triangle. For instance, if the 12 division is placed 3/8 inch from the edge of the triangle, a 3/8-inch scale results, and so on. An arrangement may readily be made by which the thin celluloid piece may be tacked temporarily in the position on the triangle corresponding to any desired scale.

Philadelphia, Pa. JULIAN C. SMALLWOOD

MACHINE ASSEMBLING HAMMERS

The machine assembling hammer shown in Fig. 1 is intended for the use of assemblers in the machine shop, where soft hammers are an absolute necessity. The table shown in connection with Fig. 1 gives the dimensions for four different sizes, and a convenient form of mold for casting these hammers is illustrated in Fig. 2. The heads are made of scrap lead or babbitt, which when heated to a molten state is

poured into the cast-iron mold. The handles are held in the heads by pins riveted at each end. The mold, as shown in Fig. 2, is made in two sections *S* and *T* which are hinged at *Y* in two places. The lug *W* is for holding the mold in the jaws of a bench vise while the metal is being poured. By means of pins *V* which pass through lugs in front, the upper half is held down when the mold is in use. It is well to have



No.	A	B	C	D	E	F	G	H	K
I	4	1½	1¾	1¼	1	1	⅝	14	¼
II	3½	1½	1½	1¼	⅞	1	⅝	12	¼
III	2½	1	1½	1	¾	⅝	½	10	3/16
IV	1¾	¾	1	¾	11/16	½	⅜	8	⅛

Fig. 1. Dimensions of Machine Assembling Hammers

these pins permanently fastened to the lower half of the mold by small chains to prevent their loss. The steel core *X* for the handle, is shouldered at one end to prevent it from slipping out of the mold. The metal is poured in through the

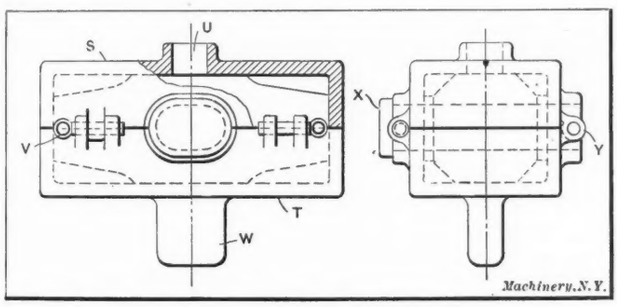


Fig. 2. Mold in which Hammers are cast

inlet *U*. By the use of these molds, soft hammers may be made with little trouble and they will also be neat in appearance.

L. H. GEORGER

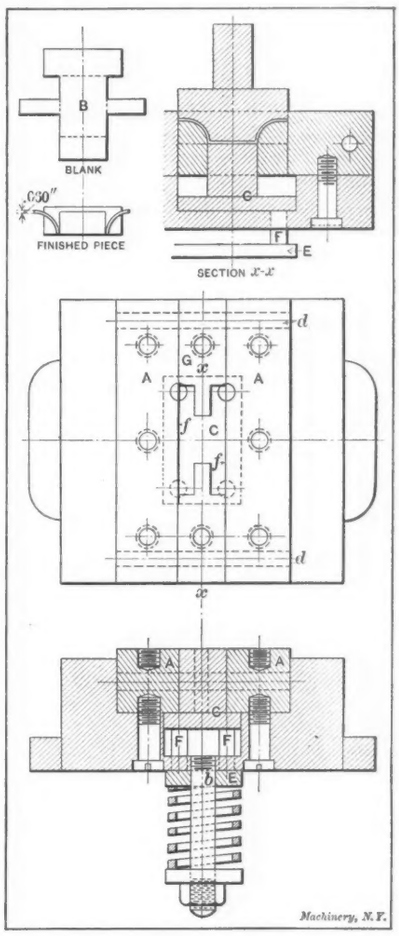
Buffalo, N. Y.

BUILT-UP REVERSIBLE-SECTION BENDING DIE

The die illustrated herewith is for bending the brass blanks *B* to the finished shape shown, the pieces being bent on the dotted lines. This die replaces a solid one which was continually wearing out on the inside flat faces and which could not be repaired without making a new block. The new die is so made that its sections are reversible; thus when the faces *f* are worn, the opposite side may be turned inward. When this becomes worn the block may be turned over and the lower half of the face becomes the wearing surface, making four positions which each block can assume to compensate for wear.

The die is made of the pieces *A* which are reversible, and the sections *G* which fit between the parts *A*. The alignment is secured by dowels *d* in each end, which pass through the three pieces. The four pieces are set into a base-block which is a steel casting, and are held to it by eight screws, three in each long piece and one in each of the small pieces. This makes a very solid construction and will stand any amount of strain without danger of breaking. All the sections were made of non-shrinking steel and were hardened very carefully, all holes being plugged with asbestos. After hardening, they were ground on a surface grinder, care being taken not to disturb the alignment of the holes.

As there was not room for the stripper springs in the base-block, a heavy coil spring of one-quarter inch square stock was wound and tempered. Plate *E* is loose on the shank of the bolt *b* and the pins *F* work through reamed holes in the base-block and bear on the bottom of stripper *C*. The spring passes through a hole in the bed of the press when the die is in use. The stripper is made in two pieces as shown, one of which passes through the die, the other being a bottom plate which acts as a stop.



Reversible-section Bending Die and Piece which it forms

The forming punch for the die has a round shank by which it is held in the press and which serves to hold it while machining the faces. It was held in a fixture on a lathe faceplate and the slots for bending the side projections on the blank were formed to a templet. The sides were slotted in order to bend the projections without a side-twist. Section *x*—*x* gives a good idea of the action of the die. The punch is shown at its full depth, leaving the thickness of the stock between it and the stripper.

The locating plate for the blank is not shown but it is fastened on the top of the die by screws which fit the same holes that are used to hold the die to the base.

E. C.

PRINTS WITH BLUE LINES ON WHITE GROUND

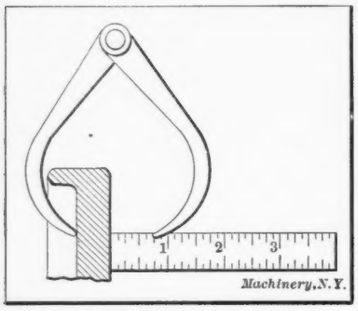
The process of making blueprints with blue lines on a white ground, described in the May number of MACHINERY is rather too complicated to be convenient. The thing may be done much more readily if one has the misfortune to be in a country where most of the carbon paper sold for typewriting is so bad that the first time it is used, the entire black surface is removed, leaving the paper practically transparent. To take advantage of this defect, one has only to place some of this paper with the smutty side up, cover it with a piece of copying paper (tissue paper), and draw or write with the stylus or even with a hard lead-pencil having a well-rounded point, whatever it is desired to print. The result will be two copies; a black or an opaque one on a white ground, and a white or transparent one on a black ground.

The carbon paper, when used as a negative with the ordinary iron paper, will give blue lines on a white ground; and the tissue paper, white lines on a blue ground.

Dresden, Germany. ROBERT GRIMSHAW

CALIPERING OVER FLANGES

A simple method and one which is as accurate as the one described in the July number of MACHINERY by Fred Horner to measure a web behind a flange is to set your calipers to some fixed distance which will clear the thickest portion, say 1 1/4 inch. Then, by the use of a steel scale, as shown in the accompanying illustration, held against the side of the part to be measured, read off the distance that the calipers extend on the scale, and deduct this amount from the distance at which the calipers are set. This will give the thickness of the web.

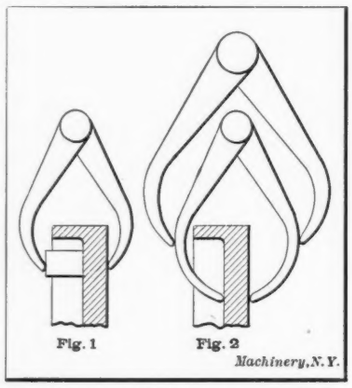


Method of Calipering over a Flange

Pawtucket, R. I. FRED G. KENYON

[A similar method was described in MACHINERY, February, 1904.—EDITOR.]

In the July number of MACHINERY was shown a method of calipering over a flange by making a punch-mark on each leg of the calipers, and measuring the points with a pair of dividers. It would not be possible to replace the calipers very closely by this means. The following methods here shown are quicker and more accurate, and also enable measurements to be taken closer to the corner under the flange. To get the thickness of the flange, simply use a block as shown in Fig. 1. Then subtract the thickness of the block from the opening of the calipers. This method can also be used for measuring a chambered recess. If a block is not handy, use a second pair of calipers as shown in Fig. 2. After removing the first pair of calipers from the work, replace them to size by means of a second pair.



Other Methods of Calipering over a Flange

Dayton, Ohio. JAMES DANGERFIELD

BOLLINCKX'S SCRAP-BOOK

In the machine shops of H. Bollinckx, Brussels, there is a very wonderful and useful scrap-book in several volumes. It consists of a series of sheets of blueprints of standard size, on which are reproduced in sketch form, hundreds of shop kinks from the various mechanical papers, with suitable inscriptions and reference to the date and page of the paper, in which, if desired, further particulars may be obtained. Copies of this scrap-book are placed at the disposal of those who may need them. This is a custom which other establishments would find well worth copying. The sketches can be made by an apprentice in the drafting-room, and in making them he will absorb a great deal of information. ROBERT GRIMSHAW

Dresden, Germany

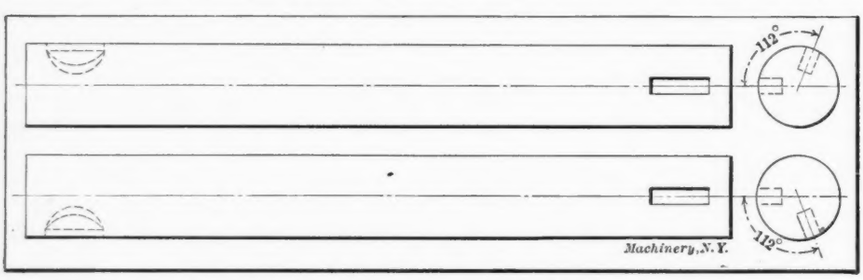
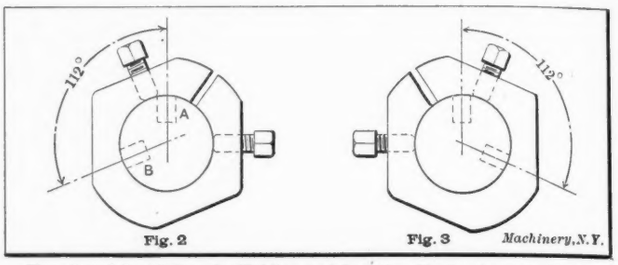


Fig. 1. Shafts with Woodruff Keyseats cut 112 degrees apart

FIXTURE FOR HOLDING SHAFT WHEN KEYSEATING

A number of cold-rolled shafts 7/8 inch in diameter and 9 inches long had to have Woodruff keyseats milled in each end, so that they were 112 degrees apart in pairs of lefts and rights, as illustrated in Fig. 1. The distance from the ends of the shafts to the center of the keyseats was 5/8 inch, and as the shafts were too short to reach through the dividing head, it was impossible to cut a keyseat in one end and use a level on it to get the position for the keyseat on the other end. The fixture in which these shafts were held while the keyseats were being milled is illustrated in Fig. 2. This fixture was first bored to a sliding fit for the shafts. Two sides were then milled parallel with each other, after which the work was indexed 112 degrees and two other surfaces were milled as shown. A 5/32-inch slot was next cut through the block and holes were drilled and tapped for set-screws to secure the fixture to the shaft. The keyseats were milled by placing the shaft in this block, which was held in the milling machine vise. The keyseat *A* was first milled at one end, after which the block was turned over, thus bringing the second keyway *B* 112 degrees from the first. This block was used in a similar manner for milling shafts with keyseats cut to the opposite hand, as illustrated in Fig. 3.



Figs. 2 and 3. Fixture for Holding and Locating Shafts shown in Fig. 1 while cutting Keyseats

In Fig. 4 a method of holding a long shaft when keyseating is shown. Two blocks are placed on the ends of the shaft to be keyseated, as illustrated, and a surface-plate or other smooth surface is used to bring the blocks into the same plane. By holding first one block and then the other in a vise while the keyseats are being milled, the latter are cut in alignment with each other. By cutting a single finished block in two, these two blocks may be made exactly alike without any difficulty. ARTHUR Z. WOLGAMOT

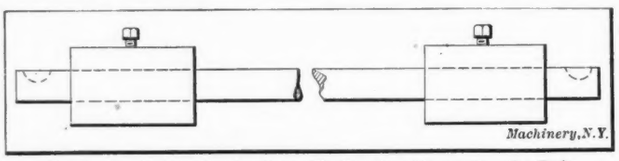


Fig. 4. Blocks for Aligning Long Shafts when Keyseating the Ends

Peoria, Ill.

IRREGULAR SPACING OF THE CUTTING EDGES OF REAMERS

After reading an article in the May issue of MACHINERY by "A," I see no reason for spacing reamers irregularly to prevent chattering and thus make accurate measurement difficult; for the chattering effect may be overcome by simply giving the cutting edges a slight spiral. A. NIELSEN

Cleveland, Ohio.

[Cutting the teeth on a helix, or spiral as commonly expressed, increases cost of production and grinding considerably, and the advantage of the spiral tooth action is doubtful. Is there a common angle best suited to steel, cast iron and brass, and if so what is it? Should the helix be right- or left-hand, and in what respect should the practice vary for machine and hand reamers? The opinions of readers are solicited for publication.—EDITOR.]

IMPROVED HYDRAULIC CYLINDER LINER

In Fig. 1 is shown a new design of hydraulic cylinder liner which does away with the troublesome features common to the ordinary cylinder liner which is shown in Fig. 2. This design shows clearly how to make feed connections to the cylinders without going through the liner. The greatest trouble as experienced with the ordinary cylinder liner

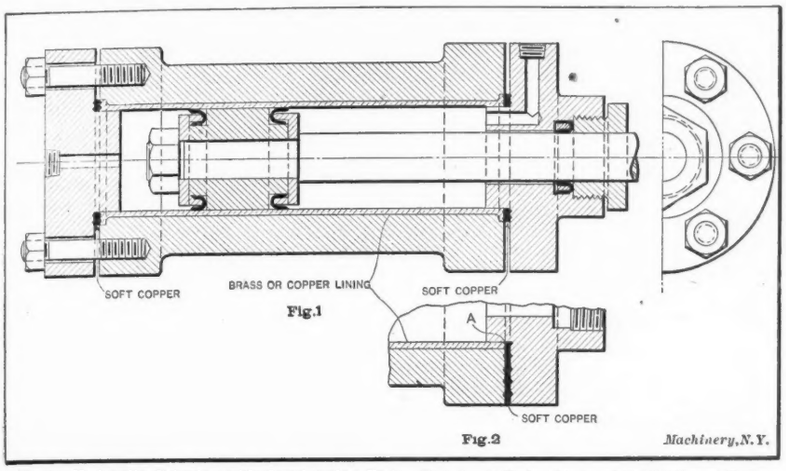


Fig. 1. Hydraulic Cylinder with Overlapping Ends. Fig. 2. Cylinder Liner of the Ordinary Type

shown in Fig. 2, is the making of a good joint at the heads.

Therefore, the reason for the failure of this joint at high pressure is easily explained. The ends and heads of this cylinder are scored or grooved and are put together with a soft copper gasket between the surfaces, which is compressed by the tension of the studs. As will be seen, this tension is not uniform over the whole surface of the gasket. Consequently the pressure of the water acting on the cylinder walls and against the head causes the former to stretch and become larger in diameter, and the latter to bulge and loosen at the gasket *A*. This stretching and bulging, though very slight, is yet enough to make a passage for the water under high pressure to reach the gasket *A*. When the water has once reached the gasket at *A* it soon makes its way between the gasket and cylinder and from there creeps in between the cylinder walls and the liner. It is very difficult to make a perfect fit between the surface of the liner and the cylinder wall and, of course, this is not improved after the cylinder has been used a while. When the water gets in between the cylinder walls and the liner the trouble begins because the water cannot get out, and with each time the pressure is put on and off there is a slight movement between the liner and cylinder. This movement causes the water to spread and make room for more water every time the cylinder is under pressure. The accummulated water soon distorts the liner and hinders the working of the piston, which, in turn, soon ruins the liner.

The design of liner shown in Fig. 1 overcomes this difficulty, and also makes a better joint which can easily be seen. The ends of the cylinder are counterbored as shown, and the liner inserted in the usual way. The ends of the liner are then lapped over into the counterbore, faced and scored or grooved, after which the heads are put on with a soft copper gasket between the joints, and the nuts shown, tightened.

To illustrate that a greater pressure is exerted on the gasket shown in Fig. 1, we will compute the difference in the area between these two joints. For convenience we will call the joint and its parts as shown in Fig. 1 *X*, and those shown in Fig. 2, *Y*. Then to prove that the pressure per square inch of area on gaskets *X* is greater than the pressure per square inch of area on gasket *Y*, assuming, of course, that the total pressure produced by the tension of the studs would be the same in both joints, let the bore of the cylinder equal 4 inches. Let the outside diameter of gasket *X* equal 5 inches. Then the area of gasket *X* equals 7.0686 square inches. Let the outside diameter of gasket *Y* equal 9 inches. Then the area of gasket *Y* equals 51.05 square inches.

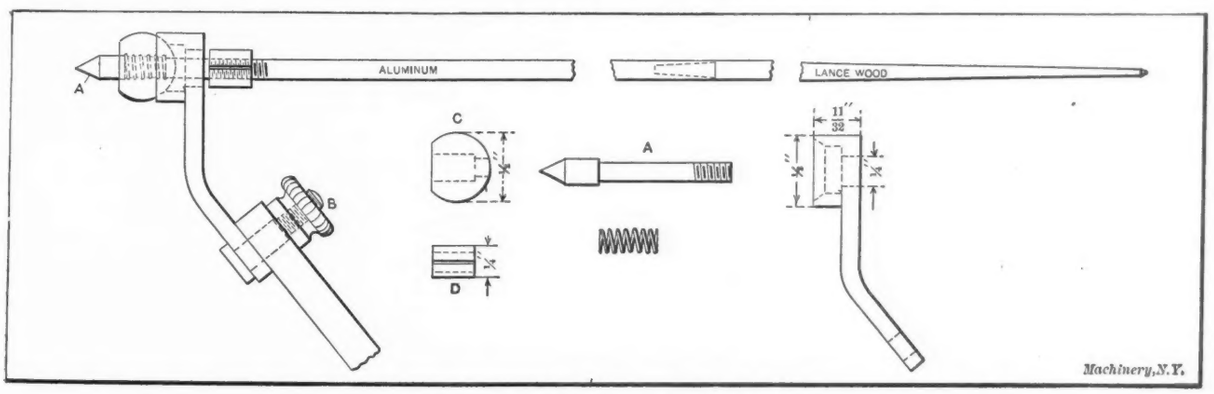
$\frac{51.05}{7.0686} = 7.22$. Therefore, the pressure per square inch on gasket *X* is 7.22 times the pressure per square inch on gasket *Y*. Hence, the joint as shown in Fig. 1 is far superior to that in Fig. 2. The extra amount necessary for the lapping over of the liner as used in Fig. 1 should be from two to three times the thickness of the liner for each joint.

BENJAMIN BROWNSTEIN

CENTER INDICATOR FOR THE BENCH LATHE

Those who have spare time on their hands may use it to good advantage by making the center indicator shown in the accompanying illustration. The ball-and-socket bearing and the light needle are the good features of this tool.

When centering a point in the lathe, the point *A* is pushed back through the ball and against the spring, the spring pushing the ball against the socket, thus eliminating all play and vibration. After setting the indicator in the tool-holder, loosen the knurled nut *B* and raise or lower the point of the tool to the desired position; then tighten the nut.



Simple Form of Test Indicator for Precision Work

If, in making the needle, it is difficult to get a good piece of wood, the handle of a paint brush may be worked to shape. When making the spherical piece *C*, use a half-inch ball bearing and grind the hole carefully. The point *A* should be hardened and ground, care being taken that it is made a good fit in the part *C*. The bushing *D* keeps the ball and needle in position when the tool is not in use, and plays no part in the working of the tool.

This indicator may, of course, be attached to a larger holder for use in a bigger lathe. I have found it superior to those on the market.

GUSTAVE REMACLE, JR.

Newark, N. J.

* * *

Charcoal should never be used on aluminum while melting, as it cannot be completely removed in skimming and black spots will be found on the castings which are made from it.—*Brass World.*

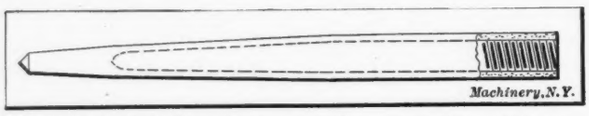
SHOP KINKS

PRACTICAL IDEAS FOR THE SHOP AND DRAFTING-ROOM

Contributions of kinks, devices and methods of doing work are solicited for this column. Write on one side of the paper only and send sketches when necessary

HOLDER FOR SHORT PENCIL

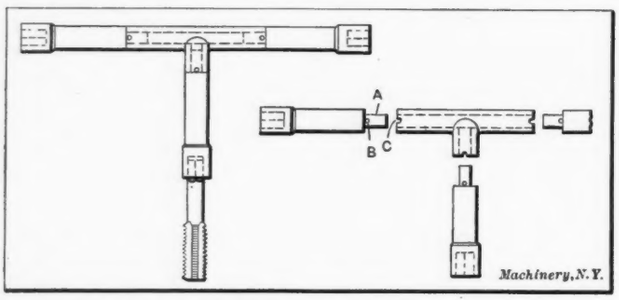
The short pencils which are thrown away by draftsmen can be conveniently used by means of the holder shown in the sketch. This holder was made from a hard rubber pen-



holder, which had been broken at the pen socket. About one inch of the solid end was cut away and the hollow part was tapped with a 5/16-inch tap. By inserting a short pencil in this threaded hole, it is rigidly held, and practically the entire pencil can be used. C. G.

TAP WRENCH WITH INTERCHANGEABLE SOCKETS

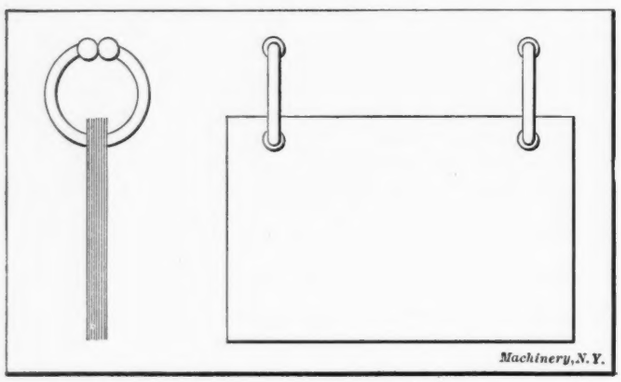
When tapping out holes by hand on heavy machine parts, such as beds, frames, etc., where several size taps are used, it is inconvenient to handle, several times, the different tap wrenches and tap extensions that must be used in operations of this kind. It also requires time to first find the various wrenches and extensions wanted. By combining three extensions to a tee, as shown in the accompanying engraving, a



tap wrench is formed having interchangeable ends of three different sizes. The changing of the extensions in the tee is tne work of a second. This tee is a forging in which holes are drilled to fit the reduced ends *A* of the extensions. Small pins *B* which fit into slots *C* prevent the extensions from turning with relation to the tee. Two of these sets in a shop will meet any condition. There should be a small set having extensions for ¼-, 5/16- and ⅜-inch taps, and a larger set for 7/16-, ½- and 9/16-inch taps. J. E. C.

LOOSE-LEAF CARD INDEX FILE

The simple form of loose-leaf book or card index file shown in the engraving, is made of suitable cards held together with two key-rings, that may be obtained in any hardware store for ten cents. I find this file very convenient, as it can be

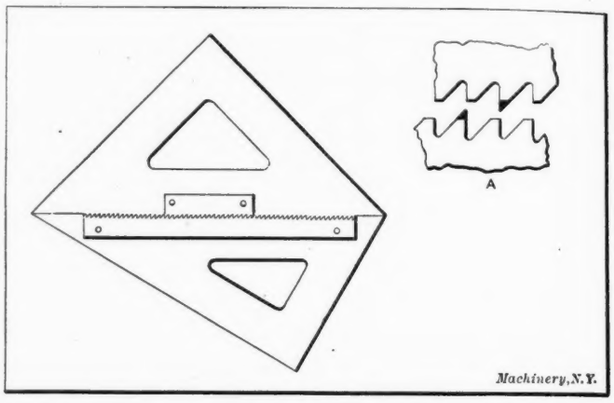


opened at any page and will not occupy more room on the desk than a single sheet or card. It has the additional advantage that a page can be taken from or added to it with little difficulty. D. F. Huddle, Jr.

Wilkinsburg, Pa.

SECTION LINER

A sectional liner, which works very satisfactorily, can be made by attaching pieces of a hack-saw blade to two triangles, as illustrated herewith. I made a section liner in this way by using an old saw blade. The blade was first annealed, after which the sides were ground and also the points of the teeth (as shown in the enlarged view at *A*) so that they would not bear in the fillets. Two pieces of blade, one 6 inches long and the other 2 inches, were then cut and drilled for pins. By using these two pieces as jigs, the triangles were drilled and the pieces attached by pins so that the long one was flush with the edge of one triangle and the short one was in mesh with the other as illustrated. When using this section liner, either one, two or three teeth can be used for

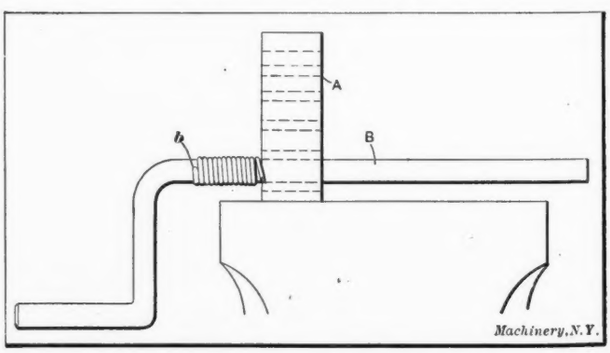


spacing. If a fine sectioning is desired, lines can first be drawn with single-tooth spacing, after which a second set can be drawn with the same spacing but with the triangles so adjusted that the last lines drawn come between the first set of lines. This attachment is easily made, and it does not prevent the ordinary use of the triangles, for when the blades are not required for sectioning, they can be removed.

Milwaukee, Wis. H. Blount

DEVICE FOR WINDING LIGHT SPRINGS

A very simple device that may be used for winding light springs is illustrated herewith. This tool will often save much time when a spring is wanted in a hurry, as springs of a variety of sizes and pitches can be made at a moment's notice. This apparatus is inexpensive and is easily made. The part *A* is made of a piece of ¾-inch square steel about 12



inches long. In this steel piece a series of holes are drilled about one-half inch apart and ranging from ⅛ to ½ inch in diameter. The mandrel *B*, on which the springs are wound, is made of wire or round stock of the size required. It has a handle formed on one end and a small hole is drilled at *b* to hold the end of the wire when starting the spring. To wind a spring, an arbor having a diameter equal to the inside diameter of the spring is selected and inserted in a hole of corresponding size in the piece *A*, which has been clamped in an upright position in the vise as indicated. One end of the wire is caught in hole *b* and, while the arbor is turned with the left hand, the right is used to hold and guide the wire. With a little practice a well-formed spring can be wound with this tool. H. B. Cohstock

St. Paul, Minn.

NEW MACHINERY AND TOOLS

A MONTHLY RECORD OF APPLIANCES FOR THE MACHINE SHOP

Comprising the description and illustration of new designs and improvements in American metal-working machinery and tools, published without expense to the manufacturer, and forming the most complete record of new tool developments for the previous month.

AUTOMATIC TWIST DRILL GRINDER

As is well known, twist drills, to give efficient service, must be kept sharp and be ground correctly, which means that the cutting edges, in addition to being of the same length, have a proper and uniform angle, that the clearance is so shaped as to give good support to the cutting edges and at the same time permit a free cutting action. In order to simplify the operation of drill grinding, A. Mill, M. E., Cincinnati, O., has designed the twist drill grinder, front and rear views of which are shown in Figs. 1 and 2, respectively. This machine is automatic in its operation and grinds drills ranging from 3/16 inch to 3 inches in diameter.

The drill, while being ground, revolves continuously at a uniform speed, and the ordinary two-lip drill oscillates twice in one revolution about a center which exactly coincides with the axis of the drill and which is more or less away from the drill point. This oscillation, which produces the required amount and form of clearance for the drill lip, is caused by a cam *C*, Fig. 3, which works against a stationary roller *B*, that

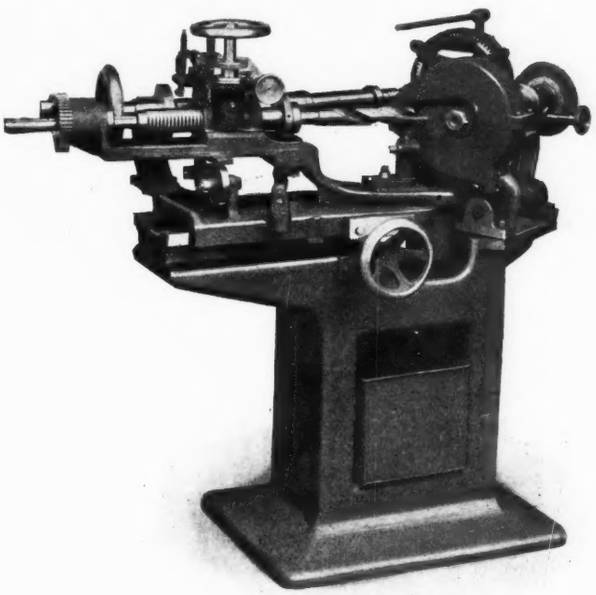


Fig. 1. The Mill Automatic Twist Drill Grinder

is attached to the carriage containing the drill-holding spindle and the feeding mechanism. The back shaft on which the cam *C* is mounted, is driven by means of a universal joint connection, and it revolves at twice the speed of the drill spindle. The drill, in addition to having this oscillating movement, is reciprocated to and from the emery wheel twice during each revolution by face cam *A*, which, through a lever, operates block *D*, Fig. 4, in which the drill spindle is mounted. The point of the drill is, of course, in contact with the wheel while the clearance for one lip is being ground; it is then withdrawn from the wheel by the face cam *A*, an amount sufficient to bring the opposite lip in the correct position for grinding. This reciprocating or longitudinal motion of the drill spindle also affects the automatic feed of the drill. The spindle in which the drill is held, revolves in a rack-sleeve or quill, which is engaged with a pinion as shown. The shaft on which this pinion is mounted, carries a handwheel *F* for the rapid traverse of the spindle and also a worm-wheel which is always in engagement with a worm. This worm-wheel is loose on the shaft, but it can be secured to it by a friction disk and hand-nut for the automatic feed. The small handwheel, shown at the front of the worm-shaft, is for feeding by hand, while the ratchet wheel at the other end furnishes the automatic feed when its pawl is released from the catch. This feed is effected, as before stated, when slide *D* is reciprocated; as this movement takes place, the pawl *H* moves with relation to its ratchet wheel, so that on the return of *D*,

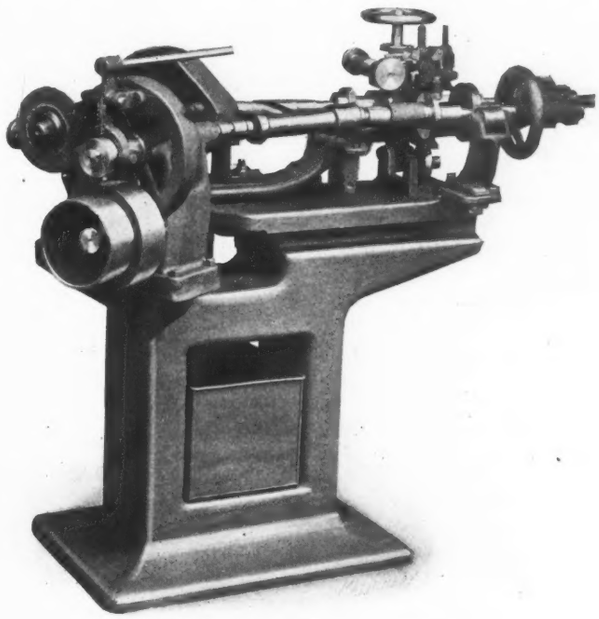


Fig. 2. Rear View of Automatic Drill Grinder

the spindle sleeve containing the drill is fed forward through the worm gearing and pinion connection. This automatic feed can be instantly released by simply disengaging the pawl from its wheel. An automatic stop can also be arranged by having an adjustable pin on the drill spindle sleeve, so located as to strike the lower part of the trip-lever and disengage the pawl.

The emery wheel frame is made oscillating to prevent the cutting face of the wheel from clogging up and also to insure uniform wear. This oscillating movement is effected by an

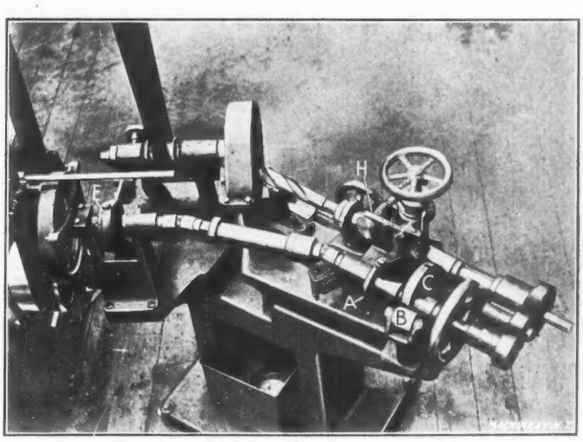


Fig. 3. Plan View of Grinder from the Rear

eccentric *E* that is mounted on the back shaft and connected to the emery wheel frame as indicated in Fig. 3. As the wheel is thus given a continuous movement to and fro, the drill will receive a smooth grinding and the wheel itself will always remain sharp. An adjusting screw is provided to lengthen or shorten the connection with the eccentric so that the entire face of the cup-wheel may be used, thus keeping the

wear uniform. The emery wheel is 9 inches in diameter and has a grinding face 1¾ inch in width.

Before inserting a drill in the spindle, the latter is moved to the end of its oscillating stroke by turning a handwheel on the back shaft until an arrow point on the spindle bearing coincides with a mark on the spindle collar. A threaded hand-nut with a conical bore serves to close the slotted spin-

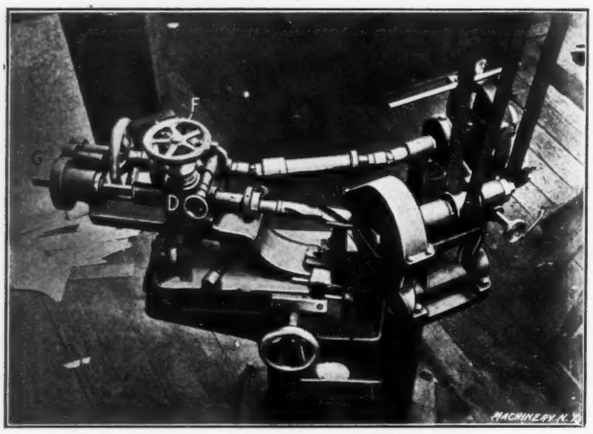


Fig. 4. Plan View from the Front

dle end around the drill shank, thus securely locking it in place after the lip of the drill has been set to a gage. These few simple adjustments in connection with the automatic operation, make it possible for a boy to operate several of the machines if necessary.

For different sizes of drills, the distance to the center of oscillation is changed according to a graduated scale by means

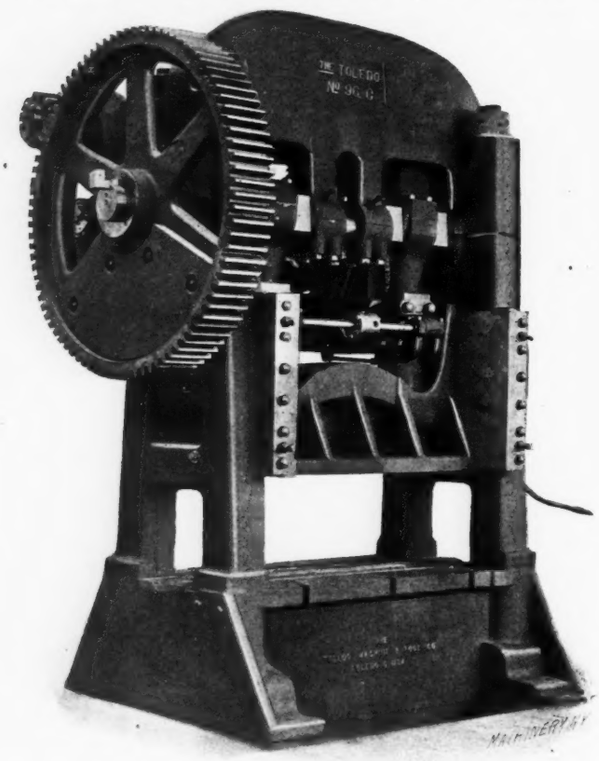


Fig. 1. No. 96 C Toledo Double-crank Press

of a handwheel at the front of the machine, which adjusts the carriage along the bed by a rack and pinion movement. As the engravings show, a small, narrow wheel is mounted at the outer end of the emery wheel spindle. This small wheel is for reducing (by hand) the thickness of the drill web at the point, when this becomes necessary. A rotary pump (not shown in the illustration) is attached to the machine for wet grinding. This grinder can be used for sharpening either right- or left-hand drills, and by the use of change gears *G*, drills having any number of lips, can be ground.

IMPROVED TOLEDO PRESSES

The two presses shown in Figs. 1 and 2 are improved patterns which have been recently designed by the Toledo Machine & Tool Co., Toledo, O. The machine shown in Fig. 1, which is designated as No. 96 C, is a double-crank press so constructed that the press operators or attendants can work on the right- or left-hand ends and on the front and rear sides of the machine. This press is double back-geared and it is operated by a friction clutch (not shown) which is located on the lower of two pinion shafts on the right-hand side in the rear. This friction clutch is operated by the hand-lever seen on the right side of the machine, which gives the operator complete control for starting and stopping at any position of the stroke or slide motion. The two pinion shafts in the rear have been elevated above the gear centers, which gives a clearance or free space from the floor line to the lower pulleys of 7 feet, so that the operators are not subjected to danger because of the driving mechanism. Large openings are provided in each of the two housings, which will permit material being passed through from one side to the other when it is necessary to form parts of greater length than the width between the housings would permit without this construction. As the illustration shows, the press frame is built up of four pieces and is reinforced by a similar number of powerful steel tie-rods. The outboard pedestal bearing is eliminated in this type of machine so that a minimum of floor space is required. The weight of the machine is 65,000 pounds; the distance between the housings, 73 inches. The stroke and the distance from the bed to the slide are made to suit specifications.

Fig. 2 illustrates the No. 59 single-crank forging-trimming press which is a new type developed for trimming drop forg-

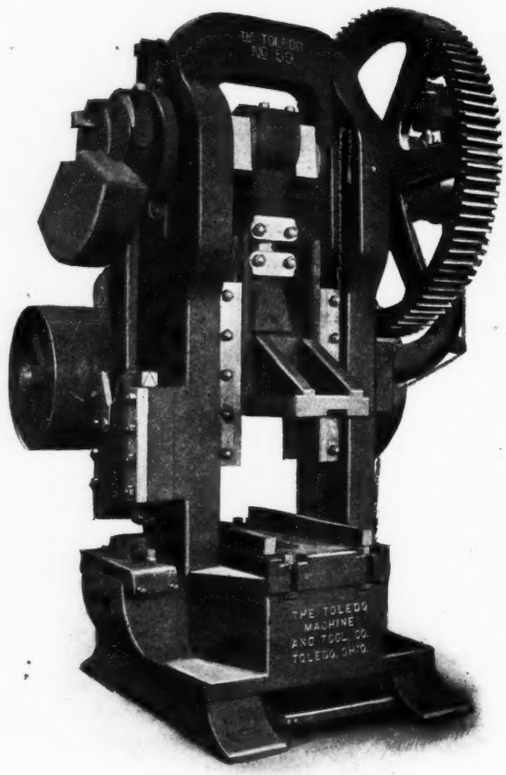


Fig. 2. No. 59 Toledo Single-crank Trimming Press for Forgings

ings. In this machine the detached outboard pedestal bearing has also been eliminated, which reduces the floor space and prevents any disalignment of the flywheel or pulley shafts. This press is operated by a powerful block clutch with gravity release or controlling mechanism. It has an unusually heavy balance wheel which, though small in diameter, provides sufficient power or momentum for obtaining the maximum output. The press is double back-geared, and it is intended for trimming long forgings for crankshafts and for similar work. The stroke of this machine is 9 inches; the distance from the

bed to the floor, 24 inches; distance from the bed to the slide, 29 inches; width between the housings, 30 inches; length of bed, 56 inches. The stroke of the outer trimmer is 3½ inches, and the bed measures 14 by 20 inches. The weight of this machine is about 42,500 pounds.

YOUNG MACHINE AND TOOL CO.'S LATHE MILLING ATTACHMENT

A lathe milling attachment that is particularly adapted for small shops and garages where there is not enough milling work to warrant the purchase of a regular milling machine, has been put on the market by the Young Machine and Tool Co., Worcester, Mass. This attachment is capable of a wide range of work and it has the commendable feature of being easily attached to or removed from a lathe. Its general construction is clearly illustrated in Fig. 1, which also shows the dividing-head, tailstock, vise, etc., while the other views, Figs. 2 to 6 inclusive, show the way it is fastened to the lathe carriage and also some of the milling operations which may be performed.

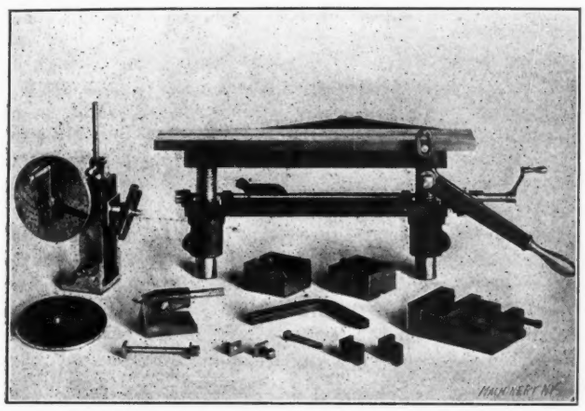


Fig. 1. Lathe Milling Attachment built by the Young Machine & Tool Co.

The attachment consists principally of a work-table that is supported by two square-threaded screws passing through nuts located in a base that is attached to the lathe carriage by two brackets, one of which is bolted to the front and the other to the rear. Meshing with these nuts, which have teeth cut in their peripheries, is a worm-shaft that may be operated by a crank at the front of the lathe to effect a vertical adjustment of the table, the nuts revolving about the screws which are rigidly fixed to the work-table. The attachment, in addition to being bolted to the carriage, is further steadied by two angle-pieces, located inside the ways on each side, one of which is adjustable, thus insuring a close sliding fit.

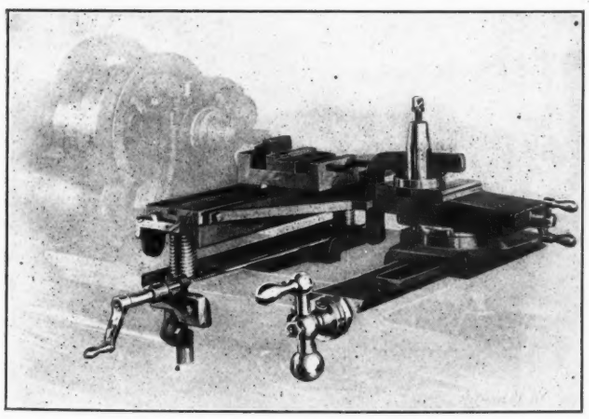


Fig. 2. Attachment set up for End Milling

Either hand or power cross-feed is available, the power feed being obtained from the lathe itself by connecting the table of the attachment with the lathe cross-slide. This connection is made by simply inserting an angle-piece in the tool-post (as in Fig. 2) and clamping it in such a position that engagement is made with a slotted side-piece bolted to the table. By this simple arrangement, a range of feeds is obtained equal to that available on the lathe. When a hand-feed can be used to better advantage, the cross-slide and table are disengaged by removing the angle-piece, which places the cross-movement of the table under the control of the hand-lever seen on the left side of the attachment. This lever is in the form of a bell-crank and it has a slotted end which engages a pin attached to the table.

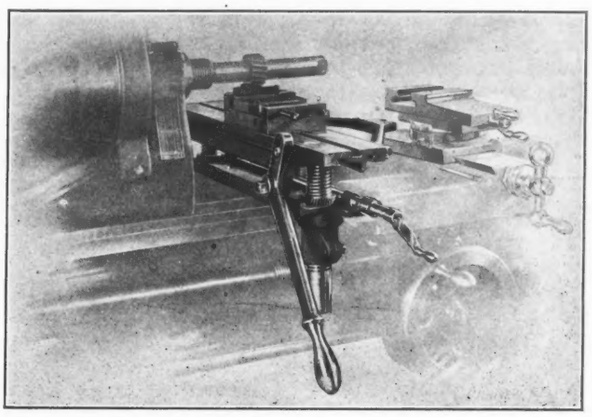


Fig. 3. Milling Light Work by using Lever Feed

By means of the dividing head furnished with this attachment, 133 divisions can be obtained which are as follows:

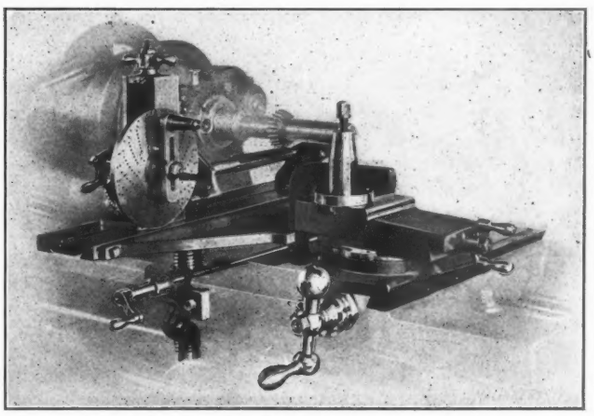


Fig. 4. Fluting a Taper Reamer

Any number from 1 to 50, every other number from 50 to 100, and beyond that irregular divisions. This head is so attached to its base that it can be swiveled to a maximum angle of 55 degrees from the vertical, and graduations are provided indicating its position. Provision is made for taking up any wear which may occur between the worm and wheel of the dividing head, and a taper gib is used to eliminate play between the table and the slide.

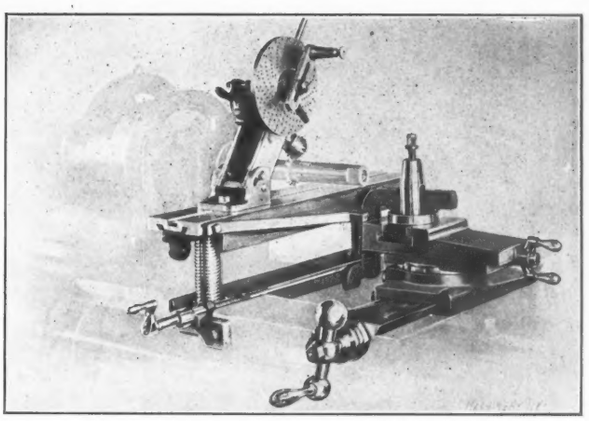


Fig. 5. Cutting a Bevel Gear

In Fig. 2 the attachment is shown set up for an end milling operation with the power feed in use, while Fig. 3 illustrates

the method of milling small parts with the lever feed, the work in both cases being held in the vise, which is part of the regular equipment. In Fig. 4 the method of fluting a taper reamer is indicated, the proper setting for the taper being obtained by the vertical adjustment of the dividing-head center. Fig. 5 shows the way the attachment is arranged for cutting a miter or bevel gear, the work being held in the spindle of the dividing-head, which is set over to the required angle. The method of using the attachment for cutting a spur gear is shown in Fig. 6, the work in this case being mounted on a mandrel between the centers. It will be noted that height

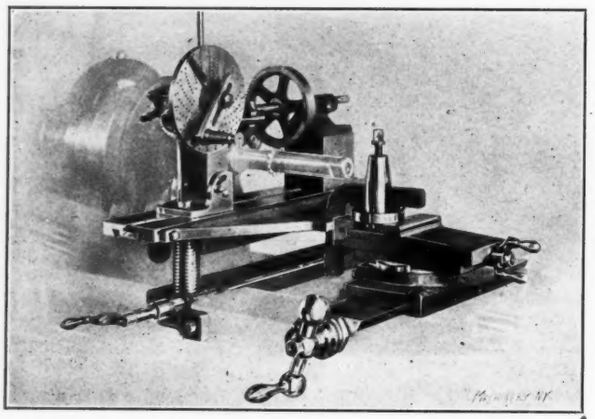
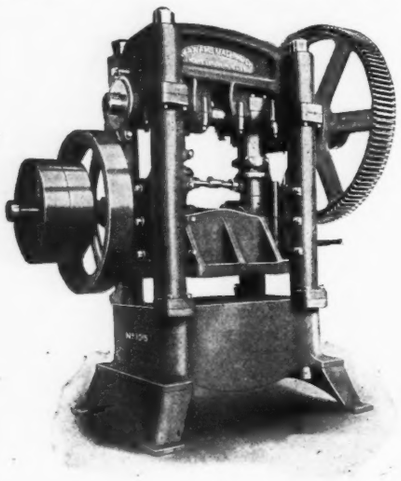


Fig. 6. Cutting a Spur Gear

blocks are used beneath the tailstock to bring it to the required elevation.

Of course, much of the work for which this attachment is adapted can be bolted directly to the table, which is provided with a T-slot throughout its entire length, and has a working surface of 4 by 22 inches. The maximum distance between the centers of this attachment is 13 inches, and the dividing-head center can be adjusted vertically to a height of 5½ inches above the table. This vertical adjustment is effected by a hand-nut at the top, which may be locked in any desired position. The spindle will be bored to receive either a No. 1, 2 or 3 Morse taper as desired.



No. 1015 Double Pitman Press built by the Max Ams Machine Co.

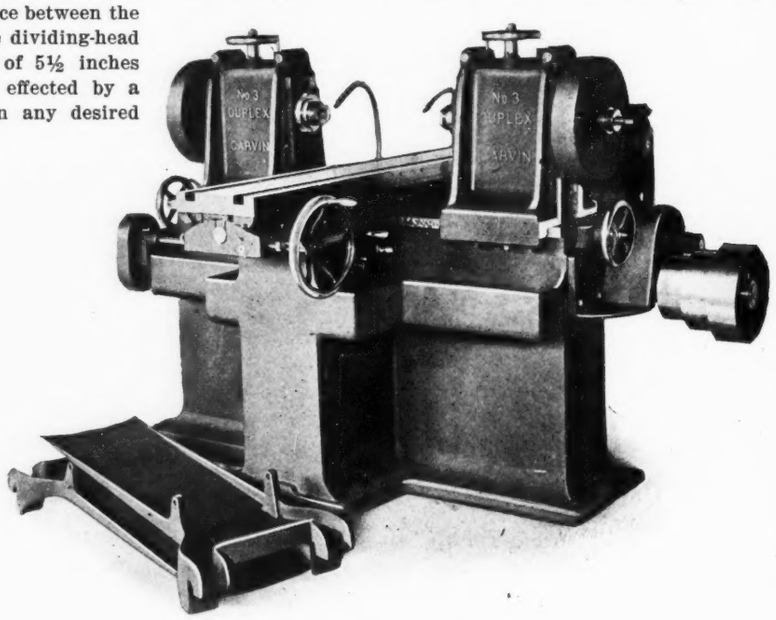
MAX AMS DOUBLE PITMAN PRESS

The Max Ams Machine Co., Mt. Vernon, N. Y., has brought out an interesting design of double pitman press, which is intended for stamping and forming operations of a severe character. The frame of this machine is of the built-up type, the entire working strain being taken by four steel tie-rods, as shown. The slide extends through openings in the uprights at each end, which makes it possible to utilize the entire length of the press bed, so that sheets 20 by 48 inches may be handled, while the distance between the uprights is only 34 inches. A sheet 25 by 25 inches can also be worked when feeding from front to back. The double eccentric shaft on this press is rigidly supported by bearings located on each side of the pitman connections as shown. The eccentrics are solid enlargements of the shaft itself, which gives very large bearings. The strain is taken directly by the main frame instead of the cranks, which prevents springing and eliminates any uneven wear. The clutch is solid with the shaft, and, besides being strong and durable, is practically noiseless. All other features common to this style of press, such as parallel adjustment of the slide, strong pitmans, etc., are embodied in the construction. The driving pulleys of this machine are 28 inches in diameter, and have a 6-inch face. The flywheel weighs 1100 pounds, and the gearing ratio is 8½ to 1. The complete weight of the press is 20,000 pounds.

GARVIN NO. 3 DUPLEX MILLING MACHINE

The Garvin Machine Co., Spring and Varick Sts., New York City, has brought out the duplex milling machine illustrated herewith, which is designed to give a longitudinal table feed of 60 inches without any deflection or cramping action in the slide. The table is 64 inches long and its bearing in the saddle has a length of 60 inches. The feed to the table is by means of a square-threaded steel worm of large diameter and a spiral rack. This spiral rack is cut from the solid on the under side of the slide, and the worm is made in halves for taking up wear. It should be explained that the grooves in the slide illustrated were made for special work, the regular pattern having three standard T-slots.

Particular attention has been given by the makers to the matter of taking care of the chips and the lubricant from the cutters. The two shield castings shown on the floor are bolted to the saddle and serve to drain all the lubricant that drips from the slide when the latter overhangs the saddle, to the oil and chip channels which are cast all around the upper edge of the base, as shown. These channels communicate with one another, and in them there are chip strainers located about half-way in their depth, thus leaving a clear oil space all around from which the pump draws its supply through a fine strainer and delivers it through flexible pipes to the work.



Garvin No. 3 Duplex Milling Machine

The drive to the spindle is from a common splined shaft through spur gearing, back-geared in the ratio of 6 to 1, from a three-step cone pulley, which is driven from an overhead countershaft. The machine has 12 positive feed changes, and 3 speed changes for the spindles. The taper holes in the spindles are No. 11 Brown & Sharpe taper, and they have the positive slot drive. A draw-rod which reaches through from the rear end of each spindle holds the taper shank of the tool firmly in its seat. The threads on the outside of the two spindles are cut right- and left-hand, respectively, and to

the standard Brown & Sharpe size of 3¼ inches in diameter by 3½ pitch. The table has a working surface of 12 by 64 inches. The maximum distance between the spindles is 27 inches, and the minimum distance, 4½ inches. The spindles may be adjusted vertically from 1¼ inch to 9 inches above the surface of the table.

AUTOMATIC KNIFE ROLLING MACHINE

Over two decades ago it was discovered that table knives could be correctly shaped by grinding them on the face of a cup wheel somewhat beveled inward. This gave the convex cross-section of blade which pleases the eye and backs up the cutting edge. The discovery was important and it formed a foundation upon which automatic knife grinding machines then and since have been built for eliminating the drudgery and uncertainty of hand work.

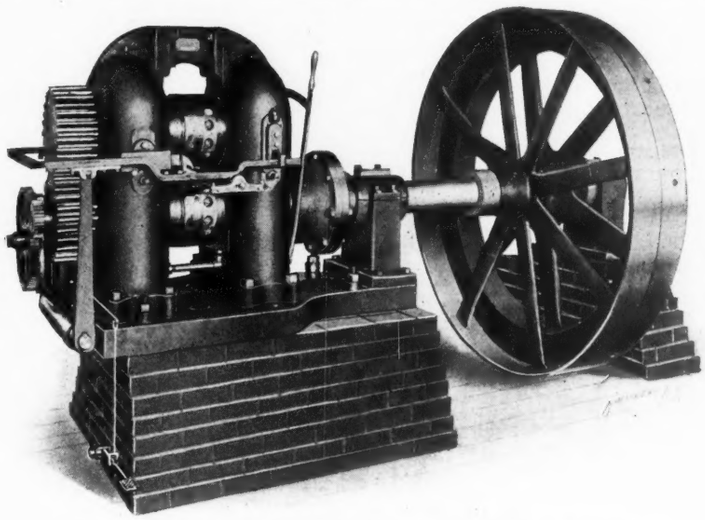
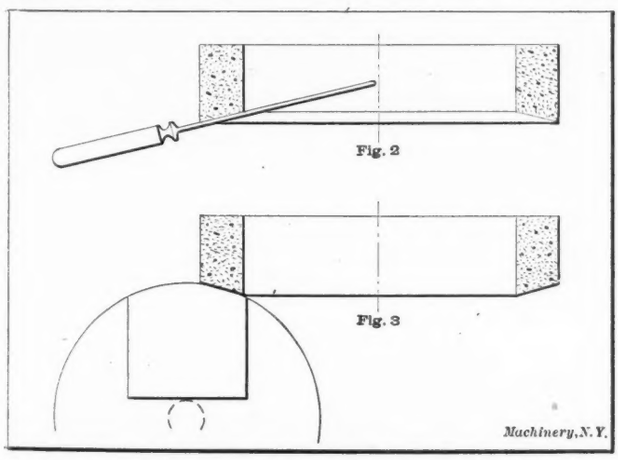


Fig. 1. Automatic Knife Rolling Machine built by the New Britain Machine Co.

Singularly enough, the same inventor, but years later, thought out the correlative process of shaping dies for hot-rolling knife blades by grinding these dies concave on the face of a cup wheel beveled in the opposite direction from the knife grinder.

The use of and connection between these two discoveries will be seen from Figs. 2 and 3 considered in connection with the cross-sections of the typical knife blade shown in Fig. 6. These sections show the uniform thickness of the cutting edge, the convexity of cross-section and the tapering back, the thickest part being at the bolster.



Figs. 2 and 3. Diagrammatical Views illustrating Use of Cup-wheel to obtain Convex Blade and Correlative Process of Shaping Rolling Dies

Previous to rolling, the knife blank appears as shown in Fig. 4, the handle and bolster having been drop-forged and the metal near the bolster spread enough in width to start rolling. It will be noted that the flash need not be removed, and that stock of either round or elliptical section may be used for rolling. Fig. 5 shows the knife as rolled automatically in two passes, and Fig. 6 the knife as finished forged and trimmed with a uniform grinding allowance.

It has been common practice for years to roll blades in interrupted or kidney rolls, running toward the operator, the work held in tongs, being pushed through and the dies forcing it back. Two passes through and back are necessary, owing to the tendency of the first rolling to bow the blade scimitar shape and to leave it rough. The second pass in second dies straightens the blade and leaves a better surface.

In hand rolling, the presentation of the work to the rolls must vary with the workman's skill, and the blank must be held for both rolling operations. In automatic rolling, with the machine illustrated in Fig. 1, the knife is always brought to the same position on the die, and as accurately transferred to the second die without the attention of the operator beyond the initial placing of the heated blank in the gripper. When this has been done, the operator can turn to the fire for a second blank while the first is still in the rolls, and he can easily maintain an output of over four hundred blades an hour—more than twice the hand rolling production. The gripper and the mechanism for transferring the blank from one die to the other are illustrated in Figs. 7 and 8, which show respectively, front and rear views of the rolls.

It has been found advantageous to use alloy steel for the dies, as they hold their shape four or five times longer than do carbon steel die blocks. These dies, which are plainly shown in Figs. 7 and 8, are held in the rolls by wedges, and they are readily removed for grinding or changing. The barring holes shown in the fly-wheel rim (Fig. 1), assist in setting the dies.

The grippers too are readily changed for handling various shapes of bolsters and tangs, a few of which are shown in Fig. 9. Fork blades are similarly rolled and held.

The hand lever with the notched quadrant shown to the right of the machine (Fig. 1), controls the thickness of the finished blade; its position may be varied while the machine is running, thus grading the thickness in steps of 0.001 inch. This machine, as illustrated, has the gear guards and belt shipper removed to more clearly show its construction.

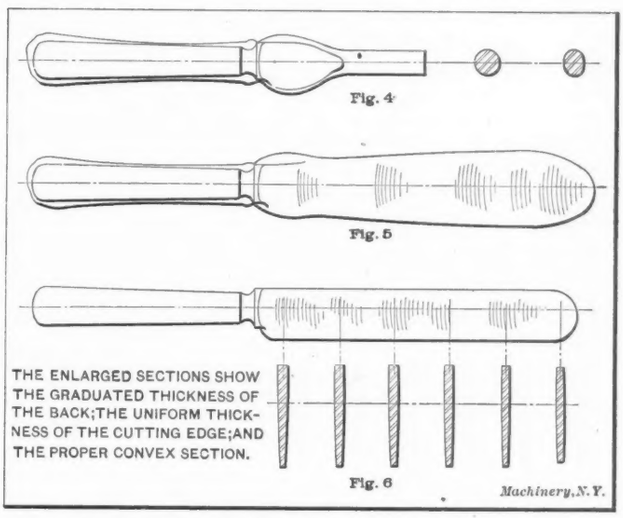


Fig. 4
Fig. 5
THE ENLARGED SECTIONS SHOW THE GRADUATED THICKNESS OF THE BACK; THE UNIFORM THICKNESS OF THE CUTTING EDGE; AND THE PROPER CONVEX SECTION.
Fig. 6
Machinery, N.Y.

Fig. 4. Blank previous to Rolling. Fig. 5 Knife as rolled in Two Passes
Fig. 6. Knife as finish rolled and trimmed

Obviously, the closer and more uniformly blades are rolled, the better for the grinding machine, as a small variation in the rolled product means fewer passes by the wheel to bring all blades to a standard. It will be clear then, that a die grinder forms an essential part of the outfit. The grinder shown in Fig. 10 has been designed to produce or duplicate any shape of die desired. The dies are shown in the left foreground with their grinding holders next to them.

Interchangeability in the cup wheels is provided for. The

wheel runs in a safety hood and the spindle in self-oiling boxes. All controlling adjustments are made without recourse to wrenches and without leaving the operating position. The wheel when in use is flooded with water through the piping shown.

These machines are patented and are made by The New Britain Machine Co., which is located at New Britain, Conn., in the immediate proximity of the largest knife concerns in this country.

WATERBURY FARREL AUTOMATIC SCREW SLOTTER

The automatic screw slotting machine illustrated herewith, which is a design recently developed by the Waterbury Farrel Foundry & Machine Co., Waterbury, Conn., embodies a number of new and interesting features which insure accuracy and high quality in the product, as well as economical production. The blanks to be slotted are automatically fed from a hopper

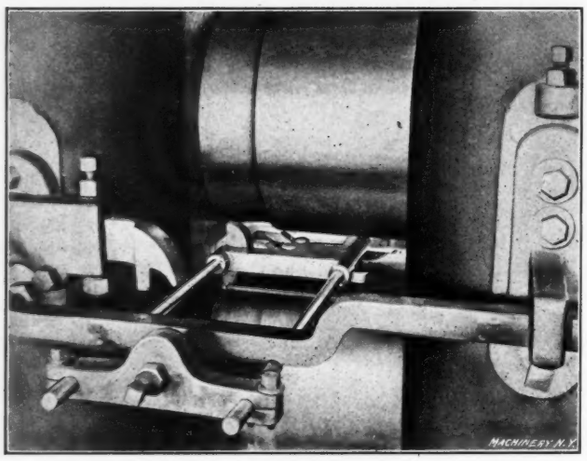


Fig. 7. Front View of the Gripper

to the slotting saw, from which they are delivered to a receptacle without attention on the part of the operator. While the slotting operation is taking place, the screw blank is rigidly held and the frame which carries the saw is also rigidly fixed to avoid chattering. This frame is provided with sensitive lateral and front-to-back adjustments, which accurately locate the position of the saw with respect to the screw-head. The saw also has an adjustment for determining the depth of the slot, which can be operated when the machine is running, and provision is made for allowing the maximum amount of time

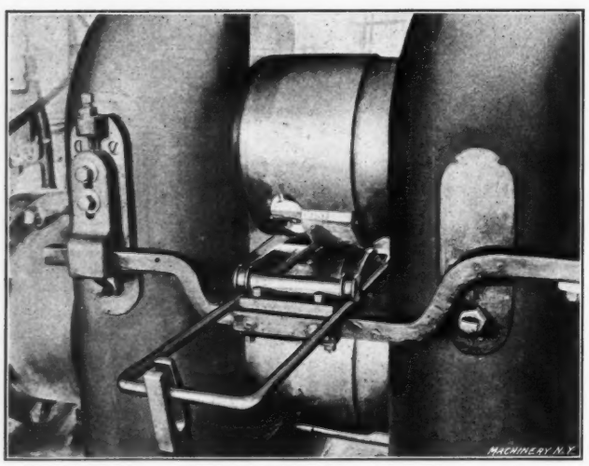


Fig. 8. Rear View of the Gripper

for slotting, even though the slots are of varying depths. The saw is well guarded, not only to protect the operator, but also to prevent the oil and chips from flying. This guard is so constructed that it may be quickly swung out of the way when changing saws.

The machine is arranged so that the chips and finished blanks are delivered into separate receptacles, the chips entering the small removable box seen in the illustration, while the screws are delivered into a pan (not furnished with the machine) placed at the right of the box. Provision is made for supplying the lubricant to the blanks and saw while the slotting is taking place. This lubricant is pumped from a tank (located below the bed), by a small geared pump, which forces it through suitable piping to the operating point, whence it flows with the chips into the chip box, where the chips sink to the bottom and the lubricant flows off the sides and drains back into the tank.

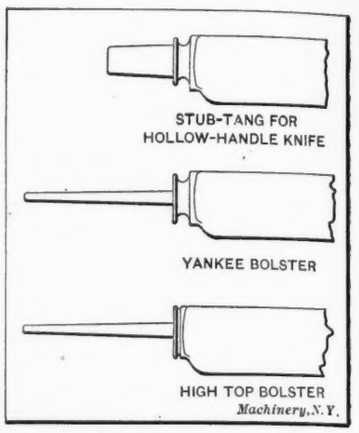


Fig. 9. Bolsters and Tangs of Various Shapes

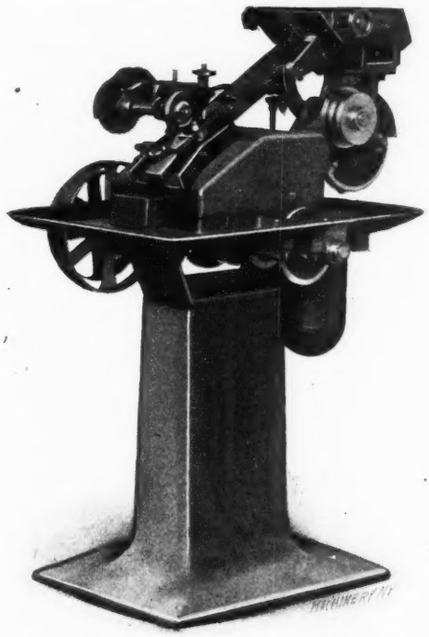
This machine can be operated at the speed which is most suitable for the particular screw to be slotted. The power for driving the saw is obtained from a countershaft, by belt on a pulley 4 inches in diameter by 1½-inch face, which is geared to the saw spindle in the ratio of 3 to 1 for steel work, while for brass a pulley of the same size is located directly on the spindle. The hopper-feeding mechanism has simple adjustments which adapt the machine not only for work which is done in long runs, but for short runs as well. To shift from

Fig. 10. Machine for Grinding the Dies

one size blank to another, it is necessary to replace two pieces only. Blanks having short shanks are handled equally as well as those with long ones within the capacity, which is 1½ inch under the head. The maximum diameter of shank for which the machine is adapted is ¼ inch. Blanks having a length of shank equal to one diameter have been successfully fed by the hopper and slotted, but so much depends upon the shape and size of the head that it is difficult to give definite information regarding the minimum lengths allowable. For this reason the builders solicit samples of the blanks to be slotted before recommending this machine. The hopper is driven by a round belt from the machine itself through cone pulleys, which provide means for speeding the hopper to suit the work.

In the operation of this machine, the blanks are placed in the hopper where they are caught by their heads in a blade or center-board, which has a slot along its top a little wider than the diameter of the blank bodies. This center-board, which, at its lower position is parallel with the bottom of

the hopper, swings vertically through the latter; as it is elevated through the mass of blanks, some are caught in the slot by their heads and are carried to the upper position where the center-board acts as an extension to the inclined chute. Here the blanks slide down into the chute, and near the point where they leave the center-board there is a rapidly-



Automatic Hopper-fed Screw Slotting Machine

revolving toothed wheel located and adjusted so that any blanks which enter the chute in an improper position are thrown back into the hopper. This leaves the entrance to the chute clear and prevents clogging. At the foot of the chute, the blocks enter what is called the carrying dial, which is 2 7/16 inches in diameter and ½ inch thick. If a blank should be held so that it was half in the dial and half in the chute, a slight special motion which is given the dial agitates the column of blanks and starts the feed after the loss of only one revolution of the machine and entirely without attention from the operator. This carrying dial has V-notches cut in its periphery in which the blanks are carried from the chute to the point where they are slotted. After this operation has taken place, the blanks are carried a little further and delivered into a receptacle.

The chute cover is hinged so that it can be swung up for removing any blanks that might become lodged. The hopper blade is made with a removable top containing the pick-up slot, which is changed for screws of different sizes. These can be furnished slotted and drilled for fastening them to the hopper slides. The carrying dials can also be furnished ready to put on the machine. The chute is adjustable for different diameters within the limits of the machine, and the design of the latter is such that it can be readily adapted to larger or smaller sizes.

The main drive of the machine is through a two-step cone pulley. The saw is held on its spindle between two clamps by a nut, no key or dowel pin being used. The size of the saws for which the machine is designed is 2¾ inches in diameter. Slightly larger saws can be used, as well as the standard sizes which have grown smaller by grinding. The saw spindle runs in bronze bushings, and the one next to the saw is tapered and split for taking up wear.

A feature to be considered in connection with this machine is the size of the head and slot. For example, a 1/8-inch screw having a very large head might be slotted on this machine, while a ¼-inch screw with a head of extraordinary size might require a larger size machine, whereas if it had an ordinary sized head, the one illustrated would handle it with perfect satisfaction.

Standard stock machines are furnished with a countershaft, a pulley for the saw spindle for brass-work, a set of wrenches, a saw and a dial, all suitable for work similar to the sample which should be furnished so that each machine can be tested on blanks for which it is intended, before shipment.

INTERNATIONAL BELT SHIFTER

A design of combination belt shifter is shown in the accompanying engravings, which, in addition to shifting the belt, retains it when in the off position, thus completely disconnecting the belt from the shaft pulley. The general construction and the method of operation of this shifter are indicated in Figs. 1 and 2, which show the belt on the driving pulley and its position when shifted, respectively.

The apparatus consists of a frame, similar in form to a segment of the pulley rim. Projecting from the curved part of this frame toward the pulley rim there are a number of spindles which carry sleeves or rollers. These rollers form a support for the belt when the latter is shifted, thus performing the function of the ordinary loose or idler pulley. The mechanism employed for shifting the belt consists of front and rear shift-bars, which are mounted in brackets and from which project rollers for engaging the belt. The front shift-bar moves the belt from the driving pulley onto the retaining rollers, and the rear bar shifts it back to the pulley. These shifters, as the engravings show, are operated by pull-chains and they are automatically returned to their original position by springs. In Fig. 3, a large shifter is shown which is equipped with two shift-bars for moving the belt from the rollers onto the pulley.

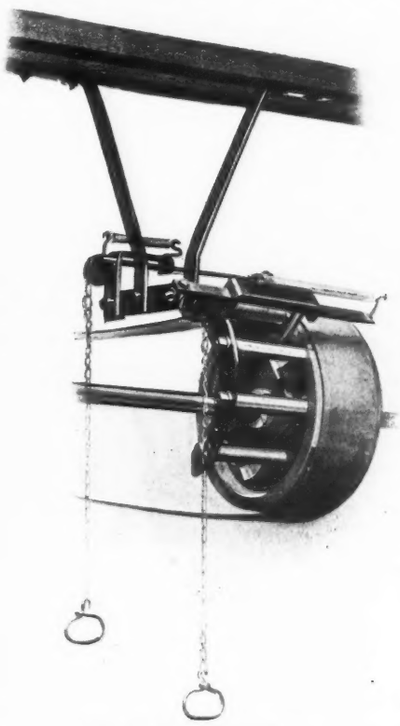


Fig. 1. The International Belt Shifter

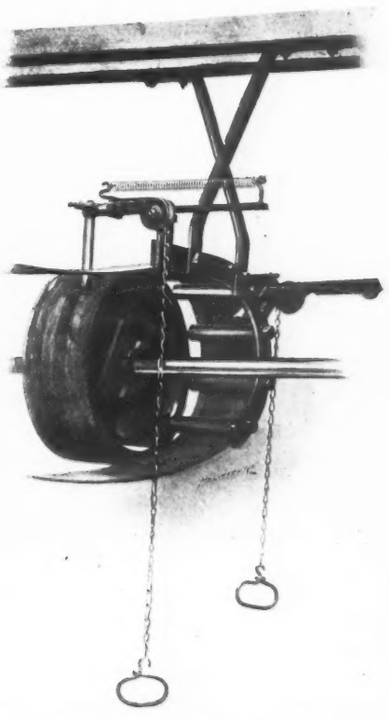


Fig. 2. View showing the Position of the Belt when shifted

When setting up this type of shifter, the straight portion of the frame must be mounted so as to be in line with the belt. The first roll is located at the point where the belt runs onto the pulley, and the first three or four rolls should be 1/8

or 3/16 inch higher than the pulley rim. A sufficient number of holes are drilled in the frame so that the shifter can be bolted to the hangers in any position. It is stated that large, as well as small belts, can be shifted rapidly and without exertion. By the use of this type of belt shifter, particularly in large plants, it will be seen that considerable friction will

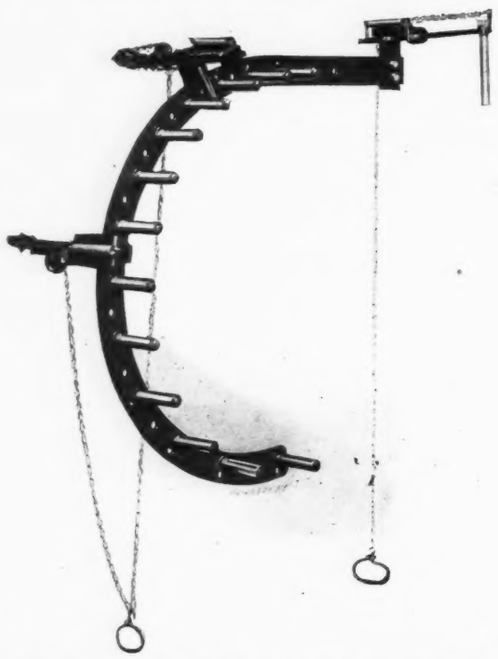
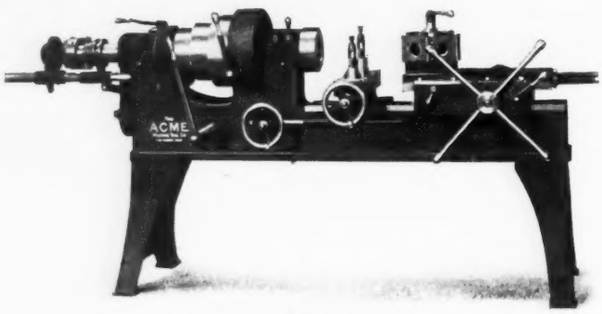


Fig. 3. Large Shifter with Two Shift-bars for Transferring the Belt to its Pulley

be eliminated and the life of the belts prolonged. It is manufactured by the International Belt Shifter Co., 624 Vance St. Toledo, O.

ACME TURRET LATHE

The Acme Machine Tool Co., Cincinnati, O., has recently brought out a line of turret lathes of the design shown in the accompanying engraving. These machines are especially constructed to withstand the strains incident to the use of high-speed steels. They are furnished with or without a power feed to the turret, and also with or without an extra capacity automatic chuck. The head is of the friction geared type and the back-gears can be thrown in or out without stopping. Two



Turret Lathe built by the Acme Machine Tool Co.

spindle speeds are available for each cone step. The turret, which is of hexagonal form, has a hole through the central stem, of the same diameter as the tool holes. Tapped holes are provided for bolting tools to the turret faces and there are independent adjustable stops for each hole of the turret. The abutment for these stops can be shifted, thus allowing a slight further movement beyond any stop, when this is desired, without disturbing the adjustment. The power feed of the turret is of the geared type, and four rates of feed are instantly obtainable by shifting a lever. The distance from the center of the turret to the top of the slide is sufficient to permit swinging large dies and turret tools. The cut-off has a hand longitudinal adjustment, and it is set low so that work of large diameter will swing over the slide. A double-friction countershaft of improved design accompanies every machine.

SNYDER 20-INCH UPRIGHT DRILL

A new design of 20-inch upright drill has recently been brought out by J. E. Snyder & Son, Worcester, Mass. While the general design of this machine does not differ from the 20-inch size formerly manufactured by this company, it is of somewhat heavier construction, the main column, the arm for supporting the table, and the base, being rigidly designed. The spindle may be fed either by handwheel or lever and the latter is equipped with a ratchet mechanism. The spindle is counterbalanced by a weight inside the column and it has a quick return motion. This machine will drill to the center of a 20½-inch circle, and its general dimensions are as follows: The vertical traverse of the spindle is 9 inches; the greatest distance from the base to the spindle, 41 inches; the greatest distance from the table to the spindle, 26 inches; diameter of the spindle in the sleeve, 1½ inch; traverse of the table on the column, 16 inches; diameter of the column, 6 inches; and height from the floor to the top of the upper cone pulley, 74 inches. The weight of the machine is 785 pounds.

BARR DRILLING AND TAPPING MACHINE

In the department of New Machinery and Tools for April, 1910, we illustrated and described an automatic tapping attachment for converting a drill press into a combination drilling and tapping machine. This attachment, which is manufactured by H. G. Barr of Worcester, Mass., has now been applied to the builder's No. 51 single-spindle drilling and tapping machine, which we illustrate herewith. This machine drills holes up to 3/4 inch in diameter, and has a tapping capacity for holes up to ½ inch in diameter in cast iron. All gears

Barr Single-spindle Drilling and Tapping Machine

are made of machine steel and the clutches and trip pins are of tool steel tempered singly. The general construction of this machine is plainly indicated by the engraving.

This tapping attachment is also applied to the Barr multiple spindle machines. With this type, the tapping spindles can be arranged in combination with the spindles having lever or power feed, in the way best adapted to meet individual requirements.

MOLINE MULTIPLE SPINDLE DRILL

The Moline Tool Co., Moline, Ill., has recently added to its line of drilling machinery another design of multiple spindle drill, which we show in Fig. 1. This machine is equipped with the company's regular double spiral drive, but it has a spindle feed in place of a table feed. The feed is entirely spur geared, there being no worm reduction, and the feeding mechanism is so arranged that it can be tripped automatically at any point.

By referring to Fig. 1, it will be seen that there is a continuous pinion, or what might be called a pinion shaft, running the entire length of the machine. Meshing with this pinion shaft for each spindle is a combined gear and pinion, so mounted on a swinging stud that the pinion can be brought into or out of mesh with a large gear *A*, Fig. 2. This gear is mounted on the same shaft as the feed pinion *B*, which

meshes with a rack cut in the spindle quill. On the lever *C* which carries this swinging gear and pinion, a feed handle is mounted, so that when this handle is pulled down, the feed is thrown in and locked, and when it is pushed up, the feed is unlocked and thrown out of engagement. To the upper end of the spindle quill, a bracket is attached, carrying a stop-rod *D*, which, as it descends, engages with the tail of the feed catch *E*, thus throwing the feed out automatically. As the

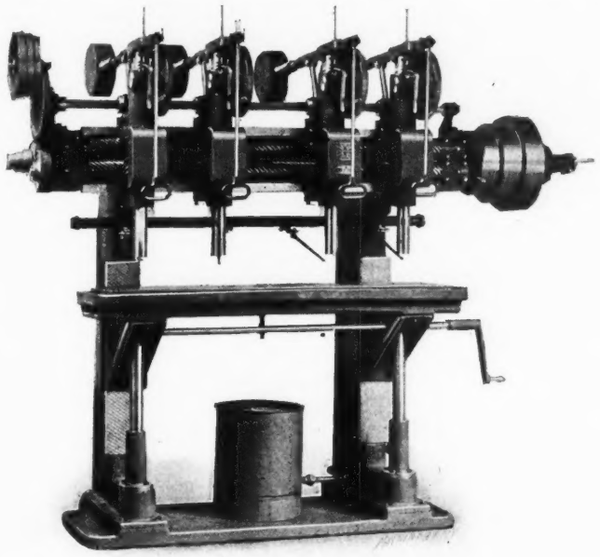


Fig. 1. Moline No. 22 D Multiple Spindle Drill with Spindle Feed

engraving indicates, this stop-rod can be adjusted to disengage the feed at any predetermined point. This arrangement of the feeding mechanism gives each spindle, in addition to an automatic stop, independent feed, which is easily controlled.

The spindles are counterbalanced, and they may be rapidly traversed by the handled rods shown. This drill has a capacity for drills up to 2 inches in diameter in steel, with minimum and maximum center-to-center distances of 6 inches

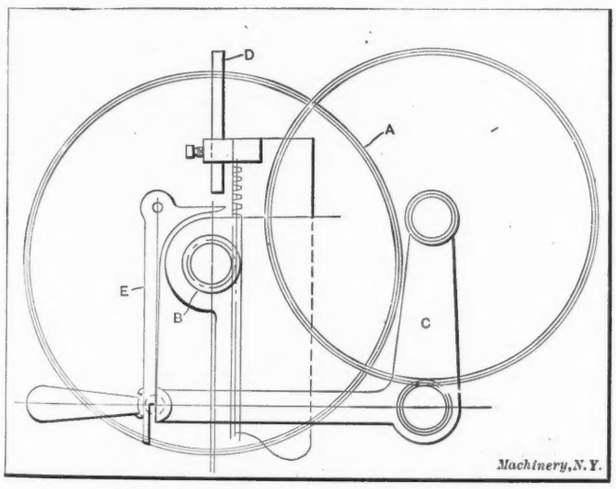


Fig. 2. Arrangement of the Feeding Mechanism

and 5 feet, respectively. The spindles run in bronze bushings and the feed racks are cut from the solid in the steel quills, which are also bronze bushed. The machine has ball thrust bearings and it is back-geared. The table is vertically adjustable by the crank and elevating mechanism shown, and it is provided with a wide channel for catching the lubricant. A pump with tank and piping will be furnished when so ordered.

REINECKER UNIVERSAL TOOL GRINDER

The increasing use of the hobbing machine for producing spur, worm and spiral gears, has created a demand for a tool grinder fitted with a spiral dividing head for grinding spiral-fluted hobs. In Europe, where the practice of hobbing gears has been developed to greater proportions than in the United States, makers of hobs have almost entirely discarded the straight-fluted type in favor of the spiral flute, their experience being that a spirally-gashed hob is more easily driven and cuts more freely than one that is straight-gashed. This has been found particularly true in the case of hobs used for cutting worm-wheels, a marked improvement being noticed when the gash runs at right angles to the thread, especially for hobs of small diameter or those having double or multiple threads. In these cases the spiral gash insures equal cutting angles for both flanks of the tool.

The tool grinder shown in the accompanying engraving, which is the product of J. E. Reinecker, of Chemnitz, Germany, is especially designed for grinding hobs as well as other spiral- and straight-fluted tools. This machine is also adapted for grinding cylindrical and taper work, and for internal grinding as well, by the use of an internal grinding attachment. Besides the uses mentioned, the machine may be employed for grinding milling cutters of all types, cylindrical and taper reamers, taps, etc. It can also be used for surface grinding on such work as dies, small plates, form cutters, etc.

Universal Tool Grinder set up for Grinding a Spirally-fluted Hob

The machine illustrated is the No. 2 size, which has a capacity in length between the centers of 25½ inches, and for diameters up to 7 7/8 inches. The table travel of the grinder shown, is automatic, but it is also built with the hand table traverse. The table is driven from the cone pulley at the base, which is connected with the reciprocating mechanism, through the column of the machine, by gears and shaft connections.

The indexing mechanism of the No. 2 machine is operated by hand, although the makers build a larger machine of the same type with an automatic indexing head, so that the dividing motion, as well as the traverse of the table, takes place automatically. The feed of the table for obtaining the correct lead for the spiral flute to be ground, is obtained by change gears the same as with the milling machine. Twenty change gears are provided, which give leads ranging from 6 to 280 inches. The lead of the spiral flutes in the particular hob shown mounted in the machine, is 172 inches.

The longitudinal and cross-slides are mounted on a base which swivels on the knee, the angular position being indicated by suitable graduations. The knee itself can also be swung about the column and, as the engraving shows, it can be adjusted vertically on the column by a handwheel at the side, which connects through bevel gears with a vertical ele-

vating screw, that passes through a nut supported by a projection on the base. On the back end of the spindle, a fixture is arranged for grinding thin milling cutters and plain tools on a hand-rest.

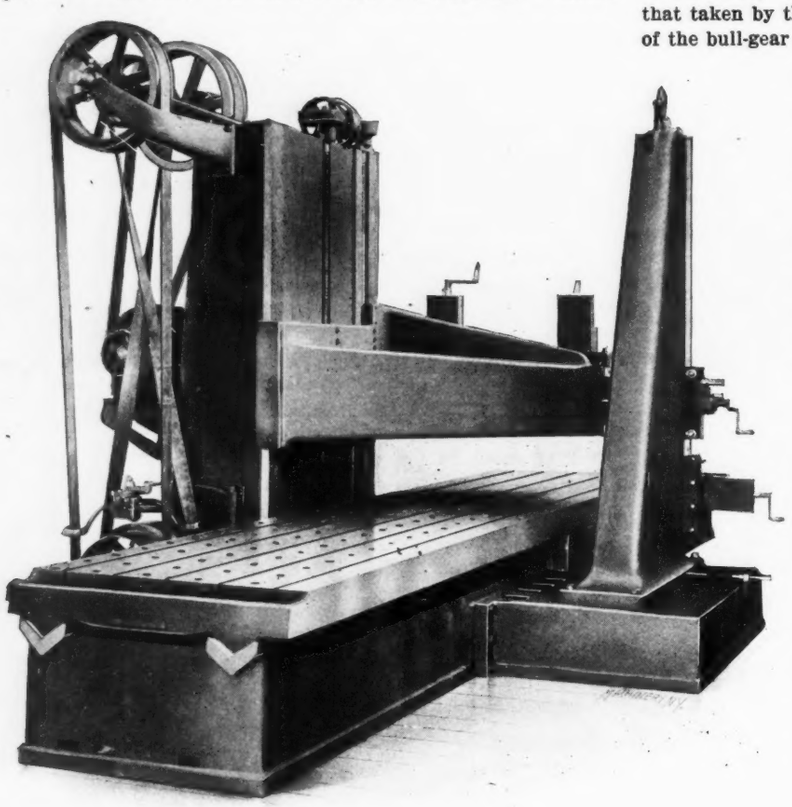


Fig. 1. Cleveland Open-side Planer with Removable Column for Supporting a Fourth Head

The Carpenter-Kerlin Gear & Machine Co., 77 White St., New York City, are the American agents for this machine.

CLEVELAND OPEN-SIDE PLANER

The Cleveland Planer Works, 3150-3152 Superior Ave., Cleveland, O., has recently added to its line of open-side planers the 60- by 84-inch machine illustrated herewith. This planer is arranged with an outside column which may be employed to support a fourth head when such an addition can be used to advantage. It should be stated that this is the sole function of the extra column which is not intended as a stiffener for the cross-rail. The bed of this planer, and also the column and cross-rail, are of box section, which gives a stiff and strong construction. The bed is cast closed on the top and it has a number of solid cross-ribs located at frequent intervals. The column is cast solid with the bed up to the table level, at which point the upper section is securely bolted and doweled to it as shown. The cross-rail, which is raised and lowered by power, has an extremely broad bearing on the face of the column, as the engraving shows. It is square-gibbed to the column and can always be drawn up parallel to the table. The heads can be operated from either side of the machine, and automatic feeds are provided in all directions. The side-head has a broad bearing directly on the column and it can be lowered entirely out of the way when it is desired to use the rail-heads close to the table. The table has a depth of 9½ inches, and it is provided with T-slots and holes at frequent intervals which are not bored through. The bull-gear pinion is of forged steel and integral with its shaft. The bearings for the bull-gear are in heavy bosses cast in the sides of the bed and they occupy the entire space between the sides except that taken by the bull-gear hub. All gears with the exception of the bull-gear and its pinion run in oil, and all the bearings are lined with phosphor-bronze. These bushings are pressed in so that they can easily be removed at any time, when worn, without interfering with the alignment of the machine in any way. All the gearing in the running parts can be removed from the sides of the machine, thus making it unnecessary to disassemble the planer if repairs should be needed. The large loose driving pulley runs in a box bushing set in back of the column base, thus relieving the running shaft and stiffening it out to the hub of the double tight pulley.

Some of the principal dimensions of this planer are as follows: Length of the bed over all, 21 feet 8 inches; distance between the V's, 36 inches; angle of the V's, 100 degrees; number of automatic oilers, six. The table has a length over all of 15 feet, and a width of 54 inches. The height of the cross-rail bearings on the face of the column is 36 inches; the width of the cross-rail bearing on the face of the column, 64 inches; and the length of the saddle bearing on the rail, 19 inches. The table has a return of from 2½ to 1 to 3 to 1, and the cutting speed is suited to the requirements of high-speed steels. This planer, as the engraving shows, is electrically driven, the motor being mounted on a bracket attached to the side of the column. The motor is of the variable speed type, and develops 25 horsepower.

MIAMI VALLEY 16-INCH ENGINE LATHE

The latest design of engine lathe brought out by the Miami Valley Machine Tool Co., 843 Germantown St., Dayton, O., is shown in the accompanying engraving. This machine, which is of the same general design as the single back-geared 16-inch

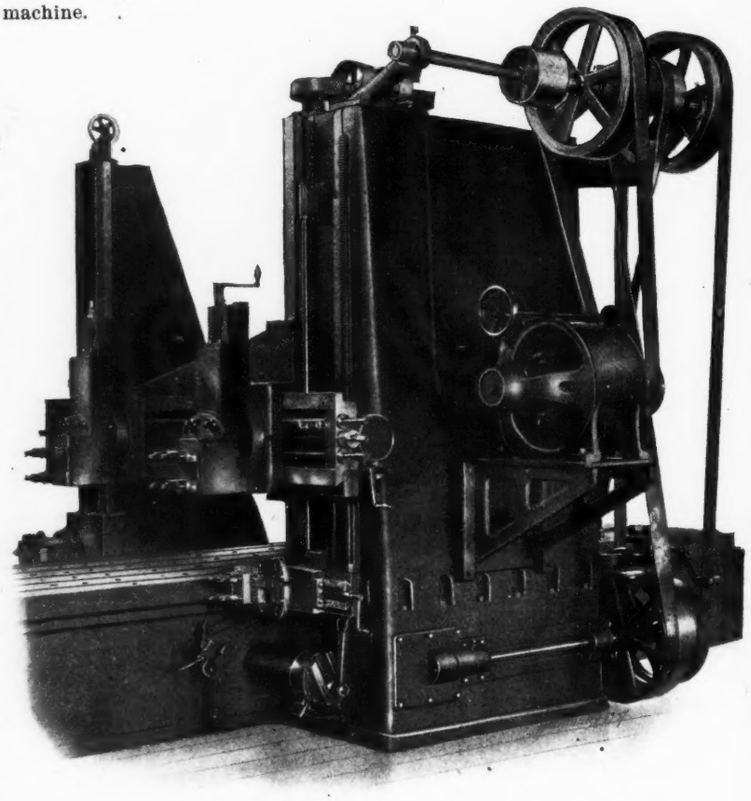
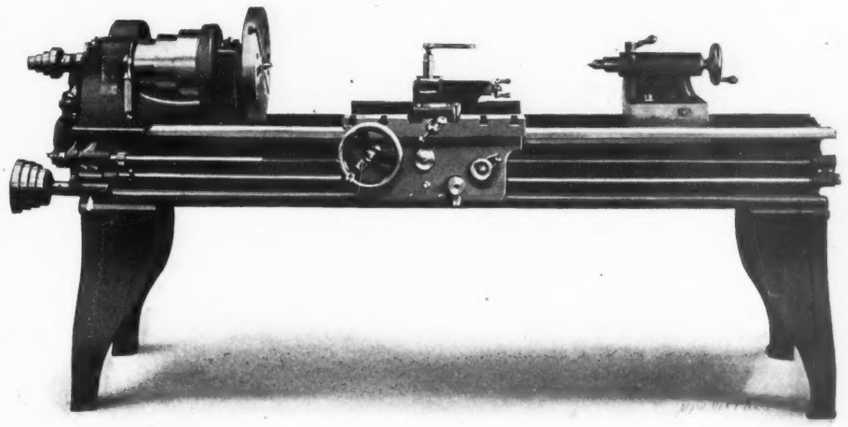


Fig. 2. Front View of the Cleveland Open-side Planer

lathe manufactured by this company, is equipped with a double back-gear and a wide three-step cone, which gives a powerful drive, thus adapting the lathe to heavy duty.

The back-gears are shifted by the hand lever shown at the front of the headstock, and their respective ratios are 5.6 and 9.6 to 1. The carriage of this lathe has a bearing 23½ inches in length, and it is gibbed both front and back. The cross-bridge is heavily ribbed, and the cross-slide and compound rest are of heavy design and well gibbed. The compound rest slide has been lengthened so as to give a feed of 5 inches. The tailstock is of the offset design which allows the compound rest to be set at 90 degrees, or in a position parallel with the bed.

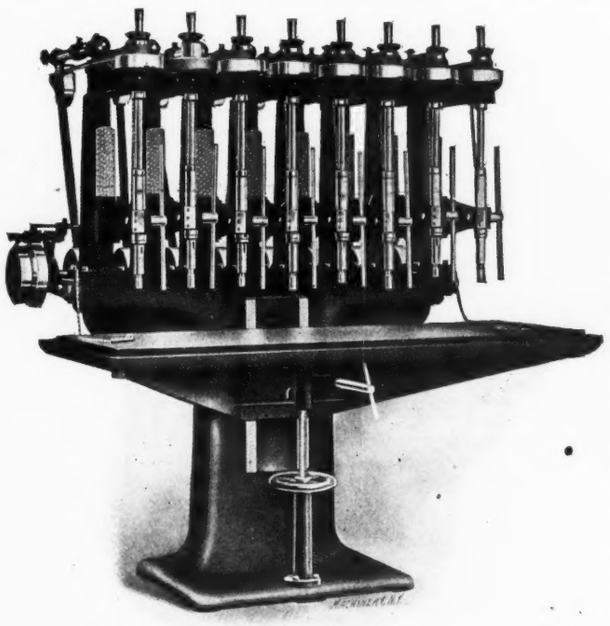
Either a belt-driven or positively-geared feed can be used on this lathe, a gear on the feed-rod meshing with either a gear on the cone-shaft or one on the screw, thus giving, in addition to the four belt feeds, those obtainable with the change gears. The thread-cutting capacity ranges from 5 to 40 threads, including 11½ threads to the inch. The regular equipment of this lathe includes a full set of change gears, a compound rest, both large and small faceplates, steady- and follow-rests, wrenches and a double-friction countershaft.



Miami Valley 16-inch by 8-foot Standard Engine Lathe

HENRY & WRIGHT MULTIPLE SPINDLE DRILL

The eight-spindle ball-bearing drilling machine shown in the accompanying engraving is a new model that is being built by the Henry & Wright Mfg. Co., Hartford, Conn. The



New Model Henry & Wright Eight-spindle Drilling Machine

new features of this design include a new dust-proof thrust bearing; a wider, heavier, and better-balanced base; a new design of idler pulley with bearings twice as large as those formerly used; a new weight chain; different design of belt guide for adjusting idler pulley; a wider table weight, and a much heavier table with oil grooves twice as wide and deep as those of former designs.

The advantages which these improvements give this machine over the older models are a heavier and stiffer construction, and a more serviceable and accurate machine. While the machine illustrated has eight spindles, these new models are built in forty-eight different styles with the spindle heads ranging in number from one to eight. The arms are made to overhang four different sizes—7-inch, 9½-inch, 12-inch, and 15-inch with tables of the correct width to match.

* * *

CORRECTION

In the description of the Colburn Machine Tool Co.'s heavy-duty drill press, which appeared in the July number of MACHINERY, an erroneous figure was given in the reference to experiments made with a 3-inch Celfor drill. It was stated that this drill was driven through cast iron at a cutting speed of 262 feet per minute; the correct speed was 205 feet per minute for the test referred to.

* * *

NEW MACHINERY AND TOOLS NOTES

Hand Vise: Wade Machine Co., Boston, Mass. Small hand vise 7½ inches long with a maximum opening of 2 inches. The parts are casehardened drop-forgings and the vise is neat in appearance and well designed.

Core Molding Machine: Henry E. Pridmore, Chicago, Ill. Machine for molding odd-shaped cores, such as cannot be produced on the usual core-forming machines because of their non-uniformity of section. The rapidity with which the sand can be jolt-rammed, the facility with which the core-box board is clamped and the box rocked over, and the accuracy with which the finished core is released from the box are among the principal advantages claimed for this machine.

Tapping Attachment: J. H. Dorman, 1 Bethune St., New York City. Tapping attachment for the drill press which is built in three sizes with capacities ranging from 0 to ⅜ inch, ⅜ to ¾ inch, and ¾ to 1 inch. The tap is held in a chuck of the floating type, and it centers in a female center in the end of the main spindle. The gears are of steel, and the body of the attachment in which they are enclosed is made of aluminum. The chucks of the two largest sizes are provided with a sliding plate which allows the use of small taps when necessary.

Hand Knurling Tool: Wade Machine Co., Boston, Mass. Knurling tool intended to be held in the hand and adapted for light knurling. It is shaped somewhat like a micrometer, two knurls being located at what might be called the anvil end, and a third central knurl in the spindle or handle, which is adjustable. This handle is hollow and contains an extra set of knurls for finer work. A maximum opening of ¾ inch may be obtained between the knurls. The body of the tool is made of a casehardened drop-forging, and its total length when fully open is 7 inches.

Storage Rack: Manufacturing Equipment & Engineering Co., Boston, Mass. Rack with shelves made of No. 16 gage galvanized-iron wire cloth for the storage of wooden patterns. The use of wire cloth tends to eliminate the warping of the patterns as they are exposed equally on both sides to the air. This type of shelves also allows the dirt to fall to the floor. The rack is so constructed that, if desired, sections can be removed, shelves can be adjusted, or new ones added at any time. This rack can also be utilized for the storage of metal patterns simply by using a heavier gage of wire cloth for the shelves.

Electric Radial Drill: United States Electrical Tool Co., Cincinnati, O. Portable electric drill designed particularly for drilling frames and for doing general work in connection with automobile manufacture. Holes may be drilled to a radius of 12 inches on either side of the vertical column, and a hand-feeding movement of 5 inches is available. The drill is made in two sizes for holes from 0 to ⅞ inch and to 1¼ inch, respectively. Either a direct or alternating current may

be used, and two speeds can be obtained. A complete illustrated description of a tool similar in construction was published in the department of New Machinery and Tools, August, 1908.

Planer Elevating Device: Cincinnati Planer Co., Cincinnati, O. Mechanism for elevating or lowering the planer cross-rail by power. It is mounted on top of the tie-piece between the housings, and is so arranged that the cross-rail may be lowered at twice the elevating speed. As the device is only used occasionally, it has been designed so that the gearing does not revolve except when it is in use. It is operated by two small clutches which are mounted on the driving shaft and controlled by a lever at the side of the housing. This lever is provided with a locking handle for holding it in a central or neutral position, so that the clutches cannot be engaged by accident.

Foster Fixed Focus Pyrometer: Taylor Instrument Co., Rochester, N. Y. Pyrometer which may be used by simply pointing the receiver tube at the furnace or other hot body whose temperature is to be measured. It is not necessary to focus the tube, and the instrument does not require accurate leveling. The only rule that must be observed when using this instrument is that the pryometer be placed within a distance equal to ten times the diameter of the hot body or opening. If the pryometer is inside this limit, the reading is not affected, so that accuracy as to distance within the limit is not necessary. The indicator is connected to the receiving tube by a flexible cable. This pyrometer is very rapid in its action, a steady reading being obtained in about 15 seconds.

Tumbling Barrel: Abbott Ball Co., Hartford, Conn. Tumbling barrel designed for burnishing, by the use of steel balls, large quantities of such articles as saddlery, hardware, buckles, etc. The barrel is built in two compartments and its construction is such that the number of compartments may be varied from one to four to suit individual requirements. Each compartment is 30 inches in diameter and 8 inches in width. This comparatively narrow width causes a pressure on articles at the bottom of the barrel, thereby increasing the friction and giving a more rapid burnishing effect because of the long sliding space for the balls which roll in and out around the pieces; at the same time impact in the barrel is eliminated so that there is no danger of denting the work.

Car Wheel Grinder: Norton Grinding Co., Worcester, Mass. Machine for grinding unmounted wheels and intended for the use of manufacturers of car-wheels rather than railroads. The machine is fitted with two faceplates cast integrally with the driving spindle. The loose wheels are attached to these faceplates by a bolt passing through cored holes in the center. The location of work is effected by means of V-supports which are previously adjusted. By simply moving a crank, these supports are moved away from the wheels slightly so that no high spots will come in contact with them when the machine is started. In each faceplate there are three half-round openings, which permit the crank-hook to be admitted to one of the core holes in the casting. By having three of these openings, it is comparatively easy to stop the machine with one of them at the top. The weight of this machine is 16 tons.

Multiple Punch: Cleveland Punch & Shear Works Co., Cleveland, O. Large multiple punch having two rows of adjustable punches, which construction permits the punching of tapering lines of holes which is often desired in punching the stakes for pressed steel freight cars. There are 34 punches in all, divided equally into two rows. The bolster blocks are so arranged that when parallel rows of holes are not desired, they can be diverted. The machine is motor-driven, the motor being connected to the flywheel shaft through cut gears, from which the power is transmitted through an intermediate shaft to the crankshaft. This machine has a 6-inch stroke, and the distance between the housings is 10 feet, 2 inches. The housings are of semi-steel castings, and the shaft of hammered steel. The bolster blocks are cast steel and all the bearings are bushed. The sliding crosshead is counterbalanced with weights hung on levers.

Electric Riveter: Electrical Machinery Sales Co., Milwaukee, Wis. Electrically-driven riveter which will punch the hole, drive and head a rivet with one pressure on the pedal. The mechanism consists of a sliding solid-steel revolving-disk block with three specially-designed striking shoes on its lower surface. These shoes strike a resilient plunger which, in turn, delivers the blow directly upon the work. The riveting operation is controlled by a treadle and the force of the blow is proportional to the amount of pressure applied. When the pressure is released, the blow is stopped instantaneously. This control is one of the advantages of the machine, as it will strike either a light continuous tap, a medium, or a heavy blow as required, and the changes are made instantly. These machines are built in either the bench, pedestal or portable types and each type is made in three sizes. They may be driven by a self-contained motor or by belt, as desired.

Wood Screw Threader: E. J. Manville Machine Co., Waterbury, Conn. High-speed wood screw threader for making wood and machine screws from blanks made by the cold-heading process. This machine has a new type of grooved-blade fan hopper, which is sufficiently rigid to overcome any "snapping" action on the part of the pick-up arm. The hopper blade is operated by a friction device which can slip in case anything gets caught, and by means of a comb or scavenger all oversized or misplaced screws are thrown back into the hopper. The feeding mechanism is self-contained and it can be removed by simply loosening two screws which fasten the bracket to the frame, when the machine is to be changed from one size screw to another. The forming shoe may also be quickly removed or adjusted and it is located where it is easily accessible. This machine is designed throughout to insure against breakage, yielding movements being provided wherever necessary. The gearing is accurately cut and it is well protected by guards.

Internal Grinder: Rivett Lathe Mfg. Co., Boston, Mass. Internal grinder with rated capacity of 3 inches, by 6-inch stroke. The table reciprocating mechanism is so designed that a positive point of reversal is assured, thus enabling the wheel to be run up to shoulders with accuracy. The table has thirty-six speed changes, six being obtained from a change gear box; this number is increased six times by the countershaft which gives six variations for the gear box driving pulley. The spindles of this machine are mounted on ball bearings in quills, and it may be equipped with spindles and quills designed to suit various classes of work. The table has an adjustable positive locating stop which may be disconnected at will for moving the table by hand, without disturbing the original setting. Both the table and wheelhead may be swiveled to any required angle, and their positions are indicated by suitable graduations. The wheelhead has an automatic power cross-feed, which may be adjusted to operate to the fractional part of a thousandth of an inch.

Expansion Boring-bar: Buck Boring Bar Co., Huntington, W. Va. Expansion boring-bar which is intended particularly for the boring of steel and cast-iron car-wheels. It has four cutters, two of which are for finishing, while the remaining two are for roughing. The finishing cutters are adjusted simultaneously by a single expansion screw that is located in the center of the bar, and the roughing cutters have an independent adjustment. The bar has a water attachment by means of which a small stream is applied directly to the point of the cutting tools, thus keeping them cool and making high speeds possible. To adjust the cutters to bore the size of hole wanted, a gage is used that extends the full width of the cutters. This gage is placed over the cutters and the latter are expanded until they come in contact with it. The cutters have a 2-inch range of expansion which enables one bar to be used for two sizes of M. C. B. standard bore. A fifth tool, located near the base of the shank, is used as a chamfering tool for giving the wheel a slightly larger bore, to facilitate starting it on the axle.

Cold Saw Cutting-off Machine: Newton Machine Tool Works, Inc., 24th and Vine Sts., Philadelphia, Pa. Twenty-six inch cold saw cutting-off machine arranged for motor drive and with four positive feed changes. The table and body of the machine, including the saddle slides, are of one solid casting. The different feed changes are engaged instantly by the movement of a single lever. Four changes of feed are provided, ranging from 0.547 to 1.109 inch per minute with a 26-inch saw running at a peripheral speed of 45 feet per minute. The spindle of the machine revolves in brass-bushed cap bearings, and the drive is by a self-contained electric motor. Power quick-return to the spindle saddle is provided which is available in both directions, if a double-throw switch and reversing motor are employed. A Brown & Sharpe geared pump supplies cooling lubricant directly at the point of cutting, and the reservoir for the lubricant is located in the base casting. The machine has a capacity for round stock up to 7½ inches in diameter, square pieces 7 inches on a side, and for 15-inch I-beams on a square or miter-cut in a vertical position.

Embossing Press: Standard Machinery Co., Providence, R. I. Toggle embossing press with extra heavy reinforced uprights and massive proportions throughout. The crankshaft is of forged nickel steel and it drives the main toggle, which is also of forged steel and bronze bushed around the wrist-pin, in a horizontal direction. The two vertical toggles, by means of which pressure is applied, are also of forged steel, and the lower one seats in a phosphor-bronze thrust shoe, which is in the cast steel slide of the press. The driving shaft is fitted with a 1300 pound flywheel which is mounted in close to the frame. The opposite end of the driving shaft is equipped with a forged steel pinion, meshing with a cast steel clutch driving gear. Both pinion and clutch gear have cut teeth, and the gear is fitted with an instantaneous patented roller friction, allowing less than 1/32 inch travel of the flywheel after the clutch is engaged. The machine has both a hand-lever and treadle tripping device, and it is set upon a substantial cast-iron base. The distance between the uprights at the bed of the press is 17½ inches and the minimum distance is 15¾ inches. For special purposes, however, the machine can be made with a minimum space of from 8 to 12 inches between the uprights for small pieces requiring heavy pressure.

Hydraulic Press: United Engineering & Foundry Co., Farmers Bank Building, Pittsburg, Pa. High-speed hydraulic forging press which is operated partly by a steam-driven, water-pressure intensifier and partly by steam working in cylinders located on top of the press, which combination gives a rapid action and the required power. This machine is built on the Davy patents, and the principle of its operation was described in an article published in the May, 1907, number of MACHINERY. In order to obtain a practical forging stroke and still keep the proportions of the intensifier within reasonable limits and the steam consumption low, the press ram is operated by steam until the forging part of the stroke is reached. The variation in water supply required for forgings of different thicknesses is obtained from a tank that is partly filled with water under an air pressure of 30 pounds. When the press head is lowered by exhausting steam from the balance cylinders, a check valve connecting this tank with the high-pressure system opens, thus admitting the required amount of water. This press is controlled by a single lever, so that the movement of the hand determines both the speed of the ram and the distance of the traverse. The forging stroke can be repeated as often and as quickly as the hand can be moved, which, in practice, is 150 strokes per minute on small presses and 60 on large ones. Nearly all parts of the press are of steel, and it is so constructed that packings can be renewed without dismantling any part or employing any power outside the machine itself.

* * *

JOINT MEETING OF A. S. M. E. AND INSTITUTION OF MECHANICAL ENGINEERS

About 160 members and guests of the American Society of Mechanical Engineers sailed for Liverpool, July 16 on the *Celtic* to attend the joint convention of the society with the British Institution of Mechanical Engineers that was held at Birmingham and London, July 26-29. Business matters prevented Pres. Westinghouse attending. W. F. M. Goss and Charles W. Baker presided.

An interesting program had been prepared for the entertainment of the members on the voyage. On Monday evening there was a reception by the officers and past presidents of the society; Tuesday evening, illustrated address by W. R. Warner: "What are the Astronomers Doing?"; Wednesday evening, musicale; Thursday evening, illustrated address by John R. Freeman: "Construction of the Panama Canal"; Friday evening, dancing; Saturday evening, conversazione, awarding of prizes for deck games, etc. The party landed July 25 and was joined by other members and guests who had gone before or by other routes. The program of their entertainment arranged for in England was replete with interesting events and is too long to be reproduced. The program of technical papers as prepared is substantially as follows: "English Running-Shed Practice,'" by Cecil W. Paget, Derby; "Round-house Practice, or the Handling of Locomotives at Terminals to secure Continuous Operation," by Frank Henry Clark, Chicago, Ill.; "Handling of Locomotives at Terminals," by Frederick M. Whyte, New York; "Handling Locomotives," by Henry H. Vaughan, Montreal, Can.; "American Locomotive Terminals," by William Forsyth, Chicago, Ill.; "High-Speed Tools and Machines to Fit Them," by H. I. Brackenbury, Newcastle-on-Tyne; "Tooth Gearing," by J. D. Steven, Birmingham, England; "Involute Gear Tooth Standards," by Wilfred Lewis, Philadelphia, Pa.; Discussion by C. R. Gabriel, New York; Topical Discussion on Rapid Production in Machine Work, by John R. Calder, Ilion, N. Y., Luther D. Burlingame, Providence, R. I., Alexander Taylor, East Pittsburg, Pa., L. P. Alford, New York; "Electrification of Suburban Railways," by F. W. Carter, Rugby; "Cost of Electrically-Propelled Suburban Trains," by H. M. Hobart, London, England; "Electrification of Trunk Lines," by L. R. Pomeroy, New York; "Electrification of Railways,' by George Westinghouse, New York.

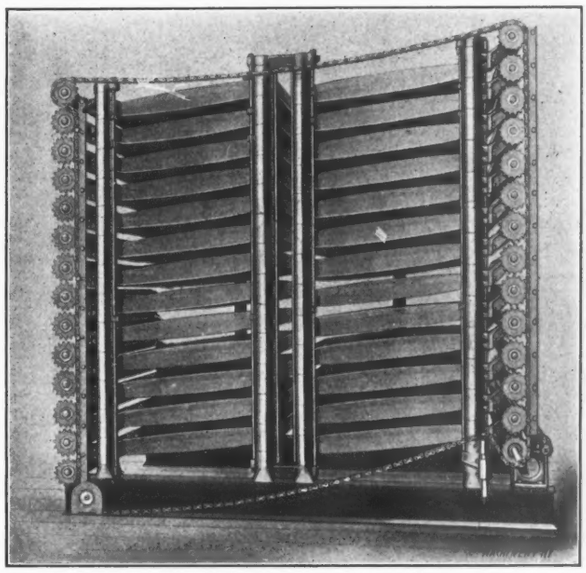
* * *

Aluminum-coated sheet metal has been placed on the market to be used in place of galvanized iron. The sheet metal, however, is not coated with aluminum, as the name would imply, but with a zinc alloy containing but a small percentage of aluminum. The alloy consists of 77 per cent of zinc, 13.5 per cent of tin, 7 per cent of aluminum and 2.5 per cent of copper. The advantage of this coating over the ordinary zinc coating is that it will not peel or strip off when the metal is bent, and a heavier coating than is possible to produce by zinc alone can be obtained.

NEW TYPE OF CHAIN DRIVE

A new method of driving series of parallel shafts or rolls has been recently patented and is now being successfully used on cell driers for drying textiles, pulp, paper, etc. This new drive, which employs a roller chain and sprockets, as shown in the illustration, is said to be much more efficient than the trains of spur gears, and the bevel gear drives formerly used.

Referring to the illustration, the drive has a set of rolls for each tray, the drying unit varying in size from six on the smallest up to forty trays on the largest machines. A single loop of 1 1/2-inch pitch Diamond roller chain made by the Diamond Chain & Mfg. Co., Indianapolis, Ind., runs around the machine and meshes with a sprocket on each roll. The lowest right-hand roll sprocket is the driver on the machine shown, and turns clockwise. The chain is kept in contact with the sprockets by means of two steel guide-rails, one on each



View of a Cell Drier showing Arrangement of Chain Drive for a Series of Parallel Shafts

side of the machine. These rails being slightly narrower than the width of the chain rollers, compel the chain to mesh with the sprockets. The lower strand of the chain runs loose and at the left of the driving sprocket an idler is provided which is adjustable vertically to take up the slack.

The bevel gears and trains of spur gears that formerly drove the rolls consumed considerable power and were noisy at high speeds. The chain is much quieter and absorbs little power in friction load. A 1/2 horsepower motor with a 1-inch belt will easily drive an empty machine of the size shown at high speed, and, as a matter of fact, this is the method used to limber up new machines. The chain drive so far has proved less expensive in initial cost and upkeep and seems to wear less than the gears formerly used.

* * *

DETROIT INDUSTRIAL EXPOSITION

The Detroit Industrial Exposition held in Detroit, Mich., opened June 20, and after a successful run attended by good weather conditions, closed July 6. There were 163 exhibitors representing principally manufacturers of mechanical or engineering products. The exposition was managed by Mr. William G. Rose, who was also manager of the Cleveland exposition, and the object of the whole thing is best expressed in the words of the little booklet issued, which are: "To teach Detroit to know itself, to teach the world to know Detroit; to advance the general interests of the city; to show the variety, scope and importance of Detroit industries; to bring benefits to the manufacturers, merchants and citizens in general; to offer the people of the city an entertainment of far greater magnitude and interest than has ever been attempted before and to stimulate civic pride, encourage the citizens to patronize home industries and advance the spirit of: 'One for All and All for Detroit!'"

MANUFACTURING THE SIBLEY HIGH-SPEED DRILL PRESS

In the manufacture of a high-speed drill press, the Sibley Machine Tool Co., South Bend, Indiana, has recently made some radical changes in its manufacturing methods which have resulted in a greatly increased production. A few of the more important of these methods, as well as the machines on which the work is performed, are illustrated herewith.

The high-speed drill press referred to is shown in Fig. 1, which gives a general idea of the work to be done, and of the parts to be bored, milled and drilled. The columns are first centered and turned in a heavy lathe. The finished part of the column is then placed in a V mounted on the table of a

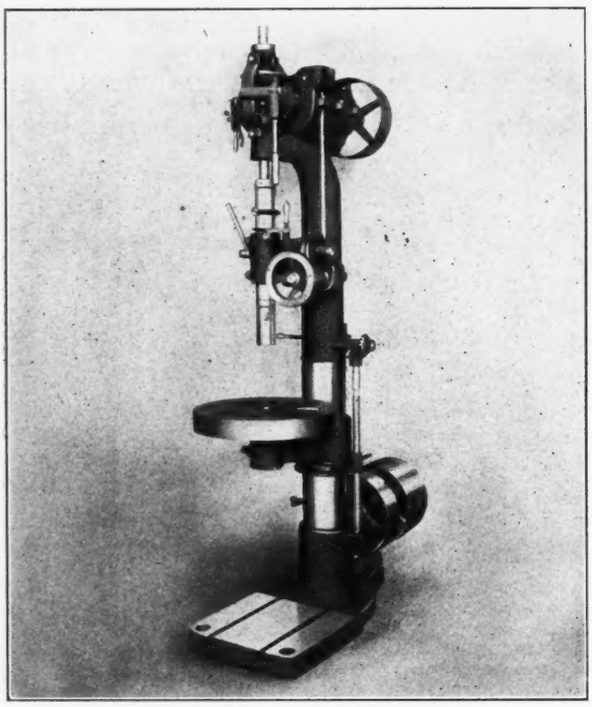


Fig. 1. The Sibley High-speed Drill Press

universal (horizontal boring machine), as shown in Fig. 2, and the top bracket to receive the gear box is milled. After this operation, the milling cutter is removed from the spindle, and a boring-bar inserted as shown in Fig. 3, and the bearings for the crown gear and spindle sleeve are bored, as well as all other parallel holes. The column is then swung around at right angles, and the hole for the pinion shaft, and other

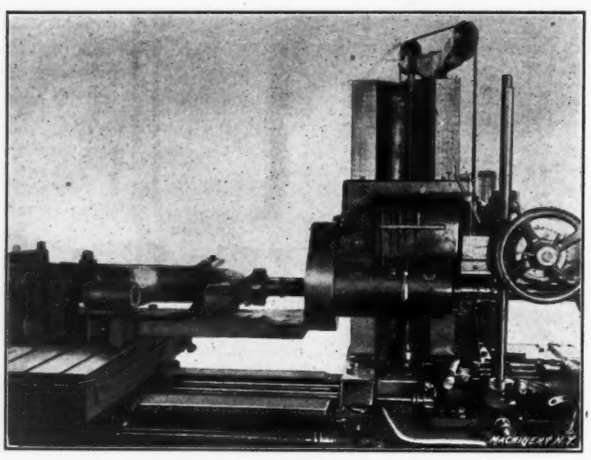


Fig. 2. Milling the Top of a Column for the Gear-box on a Horizontal Boring Machine

parallel holes are bored; this completes the work on the column.

The machining of the castings for the speed change box shown in Fig. 4, comes next. This work is also done to the best advantage on the horizontal boring machine. As will be noted from the engraving, the gear case is made in halves. The top and bottom halves are milled together and placed in a jig. The six bearings are then bored. After the gear cases have been machined, they go to the assembling department, where the bronze bearings are fitted and the gears and internal shafts assembled.

In the gear-case there are two solid shafts and one hollow shaft on which run the gears for the speed changes. The con-

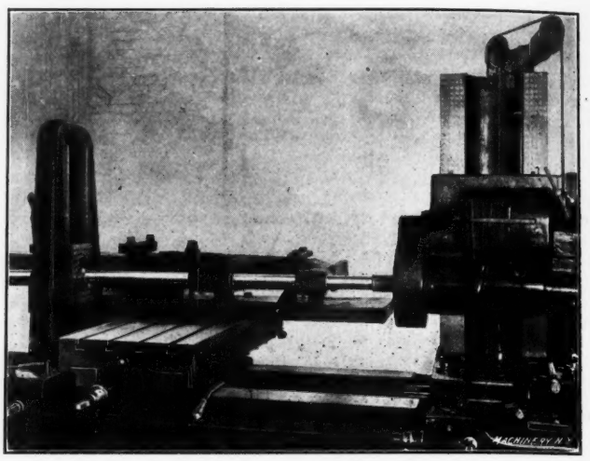


Fig. 3. Bearings for Crown Gear and Spindle Sleeve being bored

stant-speed driving pulley may be connected by either of two sets of gearing with the horizontal shaft at the left of the casing (as viewed from the front). The change from one set of gearing to the other is made by the lever in front of the driving pulley at the top of the machine. This shaft, at the left, carries a set of four gears meshing with a corresponding set of four gears on the spindle driving shaft to which the driving bevel gear is connected. By the manipulation of the lever at the front, any of the four ratios provided may

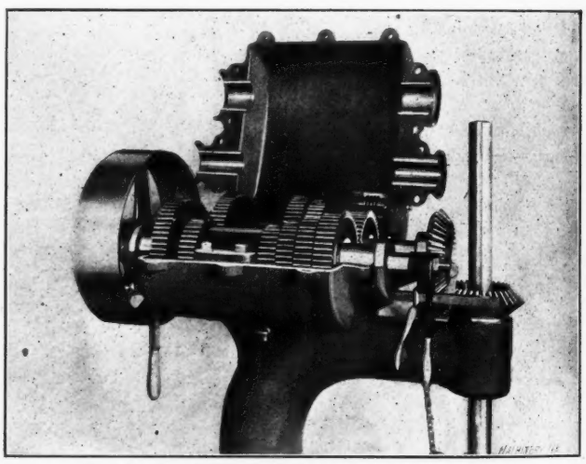


Fig. 4. Speed Change Box of Machine shown in Fig. 1

be obtained. The combination gives eight speed changes in all.

The hollow shaft for the speed change gear box is bored out of solid stock in a turret lathe and the outside is then roughed off. In each end of this hollow shaft sliding keys operate, the hollow shaft being slotted on a miller of the company's own design. After plugs are inserted in each end, the shaft is finished by grinding.

A Pfauter gear-hobbing machine is employed for hobbing the spur gears used in the speed change gear box. That the hobbing principle as applied to gear cutting will result not only in a rapid but accurate production, is now universally acknowledged and appreciated. The spiral hob by which the gear is generated, may be described as a circular rack, the thread of which is a correctly shaped rack tooth. The pitch of the threads being as the pitch of the required gear, such a hob, rotating in conjunction with a gear blank on the generating machine, produces an ideal shape of tooth, for it removes only the parts of the blank that interfere with its free

rotation. Between the straight line of a rack tooth, which would be an exact copy of the hob itself, and the curved shape of a small pinion tooth, there are as many different tooth-curves as there are numbers of teeth. The generating principle, as employed on this machine, automatically forms the correct curve required by any gear within the capacity of the machine. One hob only is required to generate gears with any number of teeth of the same pitch, from small pinions to wheels of a diameter equal to the full capacity of the machine. Prior to the hobbing operation, the rough casting blanks are bored and faced in a chucking attachment in a turret machine; they are then placed on the hobbing machine and the teeth cut, as shown in Fig. 5. After this, three keyways are cut in the loose gears. All the spur gears of the feed mechanism are cut by the hobbing process.

The hubs of the spindles are electrically welded to their shanks; they are then roughed out in a lathe, a Morse taper socket bored, and the drift hole milled on a two-spindle miller of the company's own design. The spindles are then placed in a grinder and the bearings as well as the hub and shank are

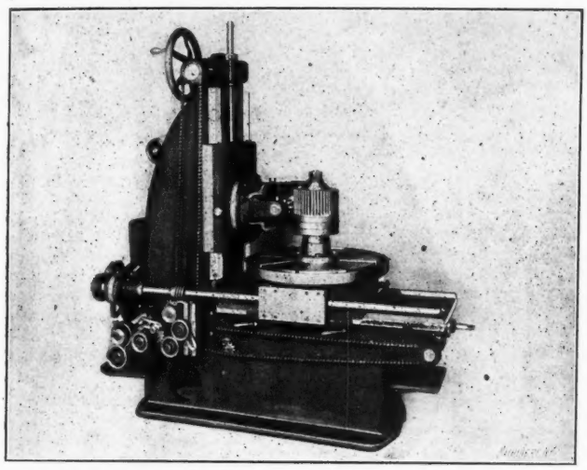


Fig. 5. Pfauter Gear-hobbing Machine generating the Teeth on a Stack of Spur Gears

ground to a finish. All shafts on this machine are ground, after first being roughed out on a lathe. The spindle sleeves, when received from the foundry, are first bored and reamed, then placed in a grinder and ground to a finish after having been graduated.

The engraving Fig. 6 shows the base of the Sibley drill being milled off in the horizontal boring machine. As will be seen, the base is bolted to an angle-plate mounted on the table. With the base still in position on the angle-plate, the hub is

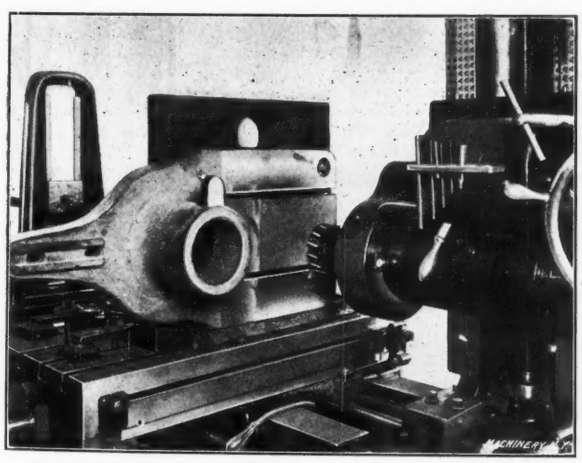


Fig. 6. Milling the Drill Press Base in a Horizontal Boring Machine

bored out and also the bearings for the table screw, as shown in Fig. 7, all three operations being done with but one setting of the casting. This method eliminates the necessity of setting up the base on a boring mill for the boring job, and then re-setting the work on a planer to finish.

The four pulleys are bored and the hubs faced in a turret lathe; they are then placed in a pulley turning lathe, and the faces turned and ground.

All the castings used in the construction of this machine are of the very best grade of iron. After several years of experience in the company's own foundry, a mixture has been selected which gives the proper toughness, as well as the re-

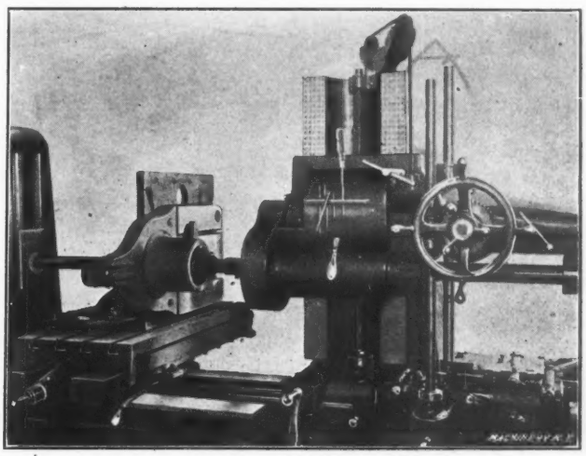


Fig. 7. Boring the Hub of the Drill Press Base

quisite softness for easy machining. Before being sent to the machine shop, all castings are put through exhaust mills which remove all core and molding sand, as well as fins and other rough surfaces.

Practically all the manufacturing on this drill press is done in one department, whence it passes into the inspector's hands. All parts that pass inspection go into stock and are drawn out by the assembling department as required. After the machines are completely assembled, they are run for forty-eight hours, and then tested. One of the tests is drilling through a hammered steel block 4 inches thick, as well as boring out the table arm to insure perfect alignment of the table with the spindle. After thorough inspection, the machines are painted, a sufficient length of time being taken to give a very nice finish. From the paint department, they pass into the shipping room ready for delivery.

* * *

A CHROMIUM ALLOY FOR EDGE TOOLS

As chromium hardens copper and its alloys to such a degree that it will take a cutting edge, James Naulty and John Scanlin of Philadelphia, Pa., have proposed the use of a copper, nickel-zinc and chromium alloy for edge tools (U. S. Patent 959,156, May 24, 1910). The alloy is as follows:

Copper	45 per cent.
Nickel	25 per cent.
Zinc	25 per cent.
Chromium	5 per cent

The method of making the alloy, the inventors say, is to melt the copper and the chromium separately and then mix, after which the nickel and zinc are introduced. It is claimed that the alloy will work hot and will take an edge good enough for edge tools, and at the same time is non-corrosive.—*Brass World.*

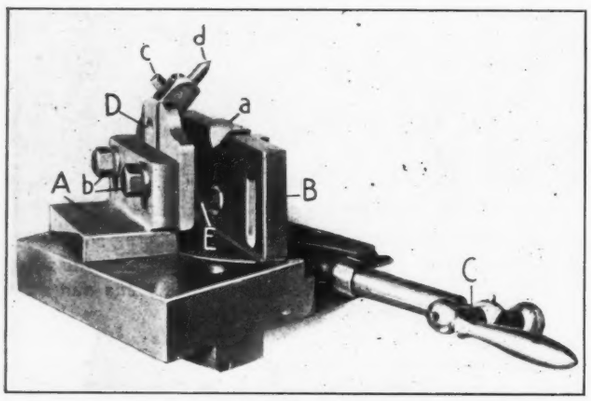
* * *

It is common practice to mount the motor of a motor-driven planer on the housings, this position in most respects being admirably suited for the purpose. The motor takes up no additional floor space, and though out of the way it is "get-at-able" whenever anything goes wrong. It is conceded, however, to be an objectionable position for the motor where highly-finished planed surfaces are required. Some concerns have so highly developed their planer practice that planed work is turned out of extraordinary smoothness of finish. If the motor is mounted on the housings the vibrations and jar due to defective balance and gear tooth action will show in the work. The inaccuracy resulting is so small as to be impossible of measurement, but the appearance cannot be tolerated on the class of work referred to, and when such work is to be produced it is probably best to mount the motor on the floor or on a separate support so that the vibrations will not be communicated to the planer housings.

ATTACHMENT FOR TURNING SPHERICAL WORK

In the July number of MACHINERY, an interesting taper turning attachment designed by W. Z. Bean, West Medford, Mass., was illustrated and described, and mention was also made of an auxiliary attachment to be used in connection with it for turning spherical work. The spherical turning attachment *A* is shown attached to the swiveling part *B* of the taper turning attachment by the adjusting screw *E*, in the accompanying illustration. The sleeve *F* containing the spindle *G* and its operating handle *H*, which was described in connection with the taper turning attachment in the previous article as mentioned above, has been removed and the spherical attachment substituted as shown. The method of operating this attachment is as follows:

After the sleeve and spindle have been removed, the adjusting screw *E* is secured in the part *A*, and is screwed into a threaded sleeve located in the part *B*, the tool-holder *D* being slotted at its lower end to clear the adjusting screw *E*. The tool-holder *D* is then adjusted to approximately the required height and held in position by cap-screws *b*. The turning tool *d* is then inserted and held in position by set-screw *c*, and it is brought to the desired position either by adjusting the part *A* by means of the screw *E* or by bringing the tool further out of the part *D*. The radius required is obtained by measuring the distance in a horizontal line between the point of the tool *d* and the face *a* of the swiveling part *B*, the face *a* being in line with the center of the plug on which the part *B* swivels. When the tool *d* is set to the desired radius the work can be turned by rotating the handle *C* in either direction as required.



Attachment for Turning Spherical Work applied to Taper Turning Attachment

* * *

WRECK OF AIRSHIP ZEPPELIN VII

The world's first airship line was inaugurated in Germany by the Aerial Transportation Co., June 22, when the third large Zeppelin airship, *Deutschland VII*, started from Friedrichshafen, on Lake Constance, to Dusseldorf. The distance of 250 miles was made in about nine hours, the average speed being about 28 miles an hour. The project came to a disastrous end on the third trip, June 28, when a party of twenty journalists was taken for a special trip. The vessel was wrecked in the Teutoburg forest by a gale which forced a descent with thirty-three persons aboard, including the crew. Tree tops pierced the silk envelope and twisted the aluminum frame, and the wind completed the total wreck of the finest of the Zeppelins, 485 feet long and costing $137,000. The passengers and crew descended by rope ladders, and no one was injured. It is said that, notwithstanding his many disasters, Count Zeppelin will build another airship.

* * *

PERSONALS

W. H. Kinsel, formerly with the Thompson-Bassett Co., has taken charge of the toolroom at the plant of the Detroit Radiator Co., Detroit, Mich.

C. L. Smith has succeeded Mr. Hall as Cincinnati editorial representative of the *Iron Age*. Mr. Smith is located at 612 Second National Bank Building.

V. M. Palmer, chief engineer of the Selden Motor Vehicle Co., Rochester, N. Y., has resigned his position to take a similar position with the Sheldon Axle Co., Wilkesbarre, Pa.

B. M. Switzer, for the past five years superintendent of the Brattleboro Machine Works, Brattleboro, Vt., has taken a lease of the works and will continue the business along the established lines.

Sylvester S. Howell has become associated with Paul Chamberlain, Marquette Building, Chicago, Ill., under the firm name of Chamberlain & Howell. The firm will carry on the designing and consulting engineering practice established by Mr. Chamberlain.

William Lodge, of the Lodge & Shipley Machine Tool Co., Cincinnati, Ohio, sailed July 16 on the *Celtic* to attend the joint meeting of the American Society of Mechanical Engineers and the British Institution of Mechanical Engineers, held in Birmingham and London, England, July 26-29.

George Cherrington, formerly with the Lodge & Shipley Machine Tool Co., Cincinnati, Ohio, and lately salesman with Brown & Zortman Machinery Co., Pittsburg, Pa., has opened an office in the First National Bank Building, Cincinnati, Ohio, where he will act as manufacturers' representative for high-speed steel specialties and machine tools.

* * *

OBITUARIES

Henry C. Clark, senior member of the firm of H. C. Clark & Son, manufacturers of paper machinery, Lee, Mass., died at his home, July 3, aged seventy-two years.

Joseph Thomas, an inventor of note, died at his home in Hoboken, N. J., July 1, aged eighty-eight years. He was born in Paris, France, and came to America at the age of nineteen. He became a machinist's apprentice and early displayed inventive genius. He was employed by Isaac W. Singer when Singer was perfecting his sewing machine in Ann St., New York, and helped perfect the oscillating feed which made the machine a success. Mr. Thomas invented the first machine for the manufacture of sulphur matches, but his principal reputation was made by the invention of the steel wire hoop skirt which was the fashionable rage in the fifties and sixties. Like many other inventive geniuses, Mr. Thomas was not a success as a business man, and did not profit largely by his numerous valuable inventions.

William Henry Brown, late chief engineer of the Pennsylvania R. R., died of heart failure at Belfast, Ireland, June 25, aged sixty-four years. Mr. Brown was assistant engineer on United States military railroads and telegraphs in 1861, in which service he attracted the attention of Col. Thomas A. Scott, then Assistant Secretary of War, and afterwards president of the Pennsylvania R. R. Co. But it was not until Mr. Brown had worked four years in various capacities on railroads, including a brief term of special service with the Pennsylvania R. R., that he made the connection with the latter in 1865, which was destined to continue for the remainder of his active life. The development of the great Pennsylvania system during Mr. Brown's connection therewith is almost unparalleled in the history of railroads. Mr. Brown retired in 1906, after forty-five years of active railroad work.

Edwin T. Marble, president and treasurer of the Curtis & Marble Machine Co., Worcester, Mass., and for nearly half a century a leading figure in the public life of Worcester, died Sunday, July 3, at his home in that city, aged eighty-two years. Mr. Marble was born in Sutton. His education was received in the Worcester County Manual Training School, now known as Worcester Academy. Entering the employ of Albert Curtis as a machinist at eighteen years of age, he worked up until, after holding many responsible positions with other companies, he entered into partnership with his former employer under the name of Curtis & Marble Machine Co. He saw the business grow to be one of Worcester's most thriving concerns, and in 1895 he became sole owner. Aside from his business interests, he served the city in many ways. He was at different times representative, state senator, alderman, member of the common council, school committeeman, besides being associated with many banking institutions and civic organizations.

* * *

COMING EVENTS

August 16-18.—Annual convention of the International Railway Master Blacksmiths' Association, Detroit, Mich. A. L. Woodworth, secretary, Lima, Ohio.

August 16-19.—Annual convention of Traveling Engineers' Association, Clifton Hotel, Niagara Falls, Canada. Subjects to be discussed are: "Fuel Economy," "Superheating," "Education of Firemen," "Development of Air Brake Equipment," "Locomotive Lubrication," and "New Valve Gears." W. A. Thompson, secretary, N. Y. C. Car Shops, East Buffalo, New York.

August 19-23.—Exhibition of nut, bolt and forging machinery at Tiffin, Ohio, by the National Machinery Co. A special excursion train will be run from Detroit for the convevance to the works of the master blacksmiths in attendance to the annual convention of the International Railway Master Blacksmiths' Association.

October 10-14.—Annual convention of the American Street and Interurban Railway Association, Atlantic City, N. J. H. C. Donecker, secretary and treasurer, 29 West 39th St., New York.

Coated paper $2.50 a year; 25 cents a copy.

Vol. 8 No. 12 **ENGINEERING EDITION** Adv. Index, Pages 36-51

GENERAL LIBRARY
UNIV. OF MICH.
AUG

THE LARGEST MECHANICAL CIRCULATION IN THE WORLD

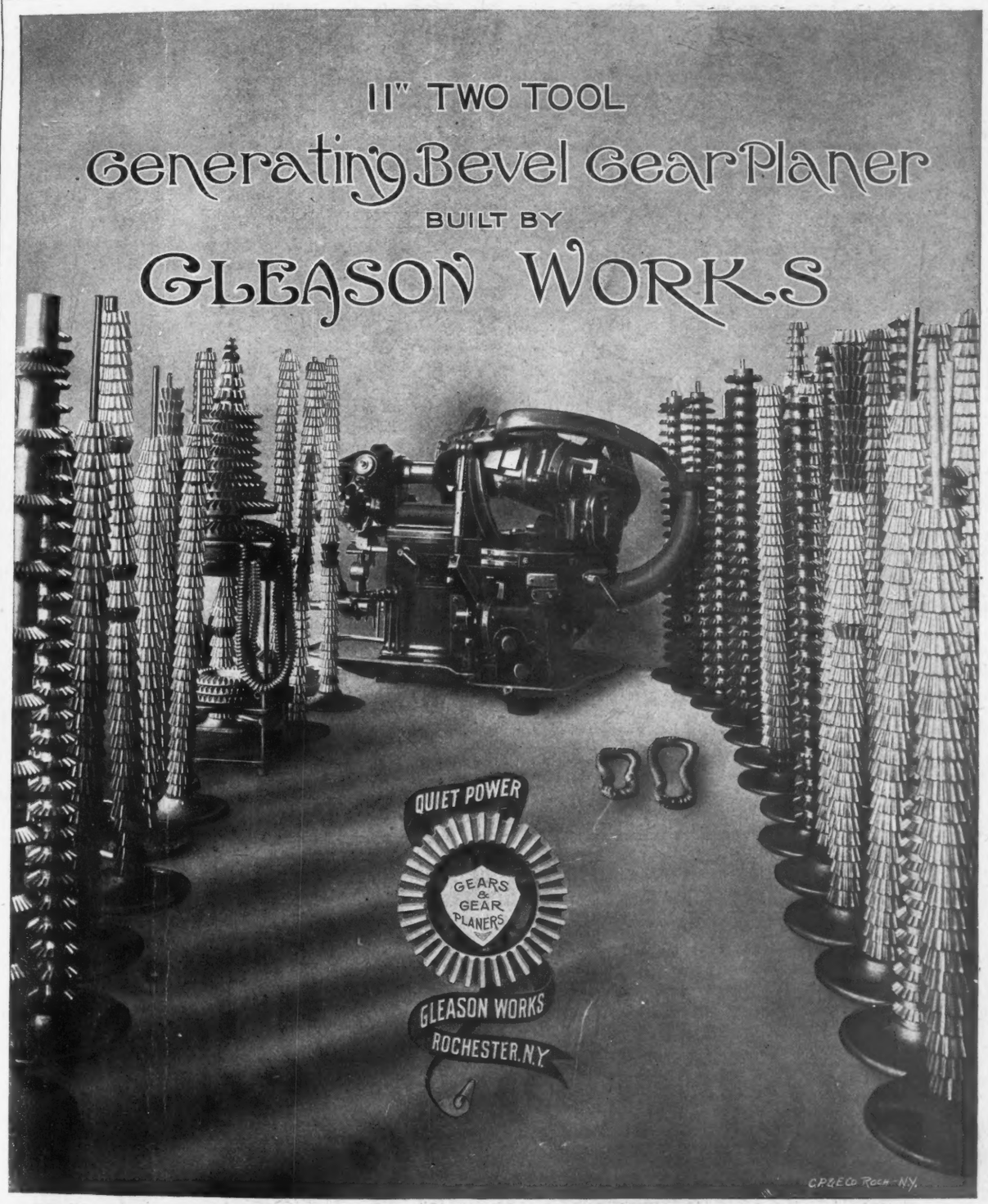
MACHINERY

PUBLICATION OFFICES 49-55 LAFAYETTE STREET CORNER LEONARD NEW YORK SUBWAY STATION WORTH STREET

Regular Edition
Vol. 16 No. 12

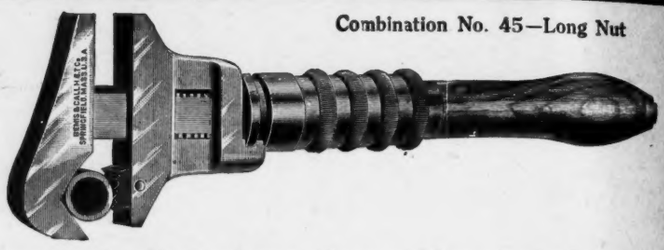
August 1910

$2.00 a year
20 cents a copy



The Strongest Double-Duty Wrench ever made.

Simple and easily adjusted; a wrench for hard, continuous service on all work within the jaw capacity.



Combination No. 45—Long Nut

TRADE B&C MARK

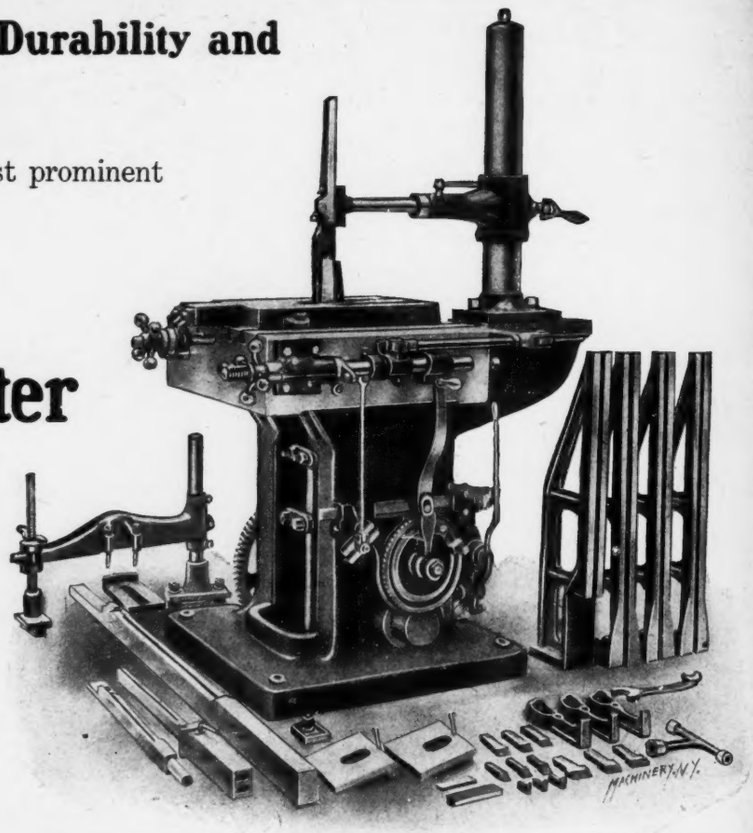
Takes the place and has the strength of half a dozen other wrenches. Large hand nut is very convenient, gives a particularly long screw bearing and adds to the gripping power. Head, bar and shank are a one-piece steel forging of highest quality. Several sizes and other types. *Send for the Wrench Catalog.*

Bemis & Call Hardware and Tool Company, Springfield, Mass.

Rapidity, Accuracy, Durability and Ease of Operation

are the features most prominent in the

Morton Key Seater



It centers the work by the bore and can be set to cut a keyway of a given size and taper, without a rule and before it is placed on the machine.

Investigate the Morton

Morton Mfg. Co.

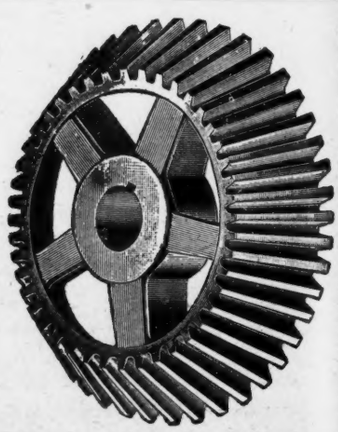
Muskegon Heights, Mich.

ACCURATE GEARS

No Defects—No Delay

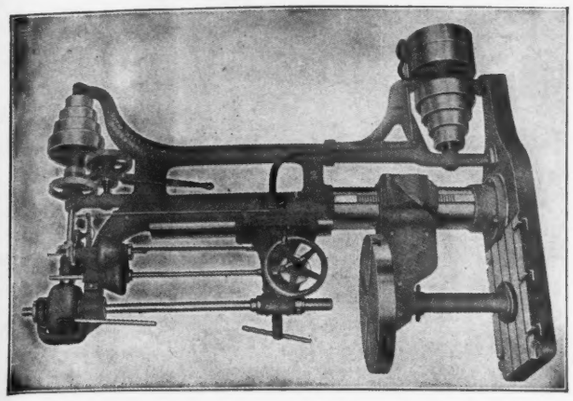
The Taylor-Wilson process eliminates gear trouble, lessens the danger of breakage, saves you money in manufacture and in service. Low first cost, for all machining is saved—long smooth work from their accurate design. No gears too large, but don't forget that we also do light and medium work.

Estimates and orders both promptly handled.



Taylor-Wilson Manufacturing Company

McKEES ROCKS, PENNSYLVANIA



Snyder's 30" Tapper

Accuracy, Rigidity, Durability, Simplicity, Great Producer. None Superior. Price Reasonable. For twenty-five years, we question if any Machine Tool, made by any firm, has had less criticism than our Drills.

New Catalogue Free

J. E. SNYDER & SON
WORCESTER, MASS.

Sizes 20", 21", 23", 25", 28", 30" and 36".
Selling Agents: Manning, Maxwell & Moore, Inc., New York City, Boston, Chicago, Cleveland, Detroit, Syracuse, Atlanta, Pittsburg, Philadelphia, Birmingham, Indianapolis, San Francisco, Mexico City, Tokio, Japan, Hong Kong, China.

THE VISE THAT HOLDS—

NO SLIPPING OR MARRING OF STOCK

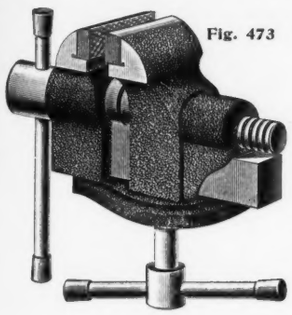


Fig. 473

Walworth Extra Heavy pipe and Bench Vise has strength enough and a powerful grip, but it will not crush pipe, mar the surface or injure work in any way.

The 5-inch solid steel jaw faces are cut very coarse to increase their holding qualities. Jaw capacity ⅛ to 6-inch pipe; weight of vise 80 lbs. Range and solidity make this an excellent vise for general shop and machine work.

List $18.00, write for discount.

A Few other Leading Specialties:

Walworth Solid Die Plates with Hills Solid Pipe Dies.

Walworth Special "Ruff and Tuft" Pipe Dies.

Millers' Reversible Ratchet Die Plates and Pipe Cutters.

Stanwood and Walworth Pipe Cutters.

Genuine Stillson Wrenches.

"Klingfast" Pipe Vise, No. 1, for pipe ⅛ inch to 2 inch.

Hall's Tapping Machine, for tapping gas and water mains under pressure.

Smith's Friction Drill Stocks.

Ashley's Nipple Holders.

Walworth Pipe Taps, Reamers, Drills, Etc.

WALWORTH M'F'G CO. TOOLS and SUPPLIES for STEAM WATER and GAS USERS BOSTON MASS.

STILLSON TRADE MARK REGISTERED U.S. PATENT OFFICE

Only the **Genuine Stillson** wrench bears this mark.

Write for Booklet of Walworth specialties.

Sole Manufacturers

Walworth Manufacturing Co., 128-136 Federal St., Boston, Mass.

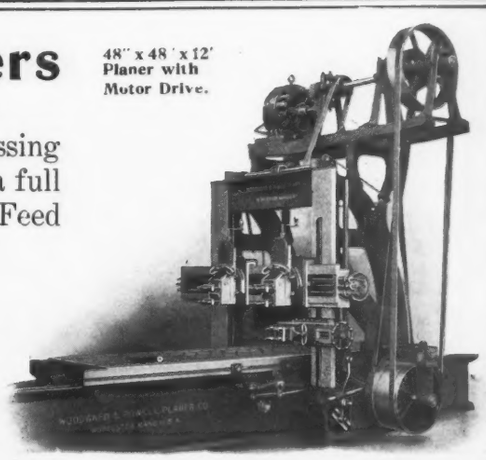
NEW YORK OFFICE: **Park Row Building.** AGENTS: Aug. Eggers, Bremen, Germany; H. Munzing, 180 Upper Thames St., London, England.

Woodward & Powell Planers

are built in sizes from 24' x 24' to 60' x 60', any length

Locomotive Connecting Rod Planers. Frog and Crossing and Switch Point Planers. Duplex Planers cutting a full stroke both ways, 48" x 18", any length. Textile Feed Roll Fluting Planers.

48" x 48" x 12' Planer with Motor Drive.



Manufactured by

Woodward & Powell Planer Co.

Established 1887 **WORCESTER, MASS.**

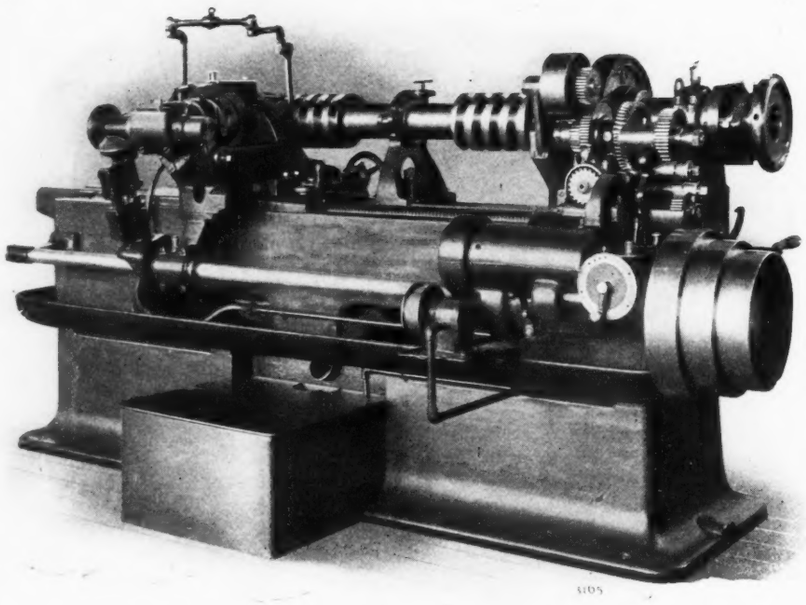
SELLING AGENTS—MANNING, MAXWELL & MOORE, Inc., New York, Boston, Pittsburgh, Philadelphia, Buffalo, Cleveland, Detroit, Indianapolis, Chicago, Milwaukee, St. Louis, Atlanta, San Francisco, Portland, Ore., Seattle, Wash., Mexico City, Mexico, Yokohama, Japan, Canton and Hong Kong, China. FENWICK FRERES & Co., Paris, France; Belgium, Italy, Switzerland and Spain. H. HAELBIG, Dresden, Germany, and Austria.

Elevator and Large Steering Worms

Either Single or Multiple, for Heavy Traction Engines, Automobiles, Hoisting Machinery, etc.

Cut on the P. & W. Thread Miller

From 5 to 15 times faster than by any other known method.



12 x 48-in. P. & W. Thread Milling Machine, cutting two large right- and left-hand worms.

Entire depth of thread cut and finished in one operation.

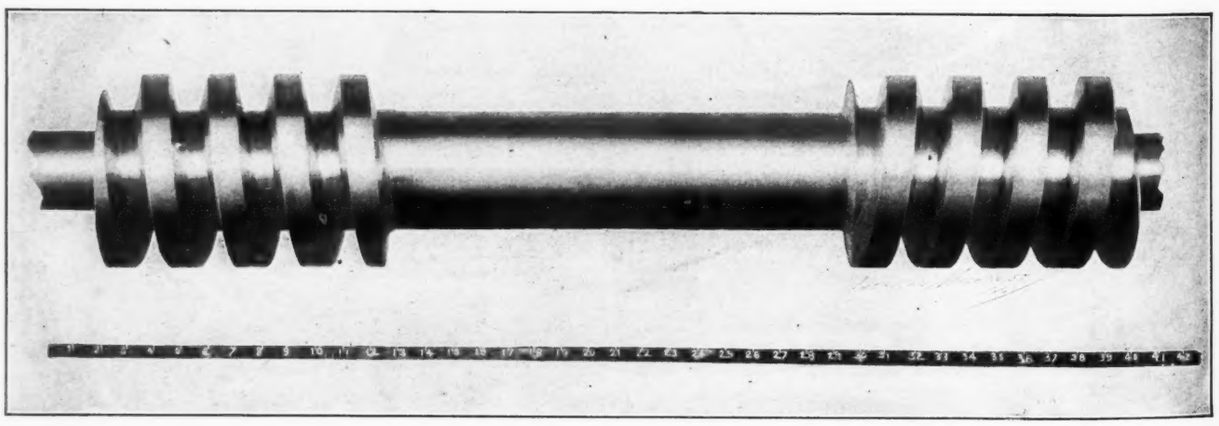
Operation is automatic, permitting one man to run several machines or be simultaneously engaged in other work.

A milled thread is precise, has a superior finish and can be accurately duplicated.

Compare this one simple, direct, automatic operation with the multiplicity and constant vigilance required for a similar operation on a lathe. The latter operation gives no absolute assurance of duplication or that the finished thread will be precise.

No other machine can equal the P. & W. Thread Miller in latitude of work, accuracy, finish, or output.

Write for Catalog "Thread Millers".



PRATT & WHITNEY COMPANY,

SALES OFFICES—**New York, 111 Broadway.** Boston, Oliver Bldg. Philadelphia, 21st and Callowhill Sts. Pittsburgh, Pa., Frick Bldg. Chicago, Commercial National Bank Bldg. St. Louis, Mo., 516 No. 3d St. Birmingham, Ala., Brown-Marx Bldg. Detroit, Mich., Majestic Bldg. Cleveland, Rockefeller Bldg., Hamilton, O. Agents for Canada, The Canadian Fairbanks Co., Ltd., Montreal, St. John, Toronto, Winnipeg, Calgary

A Little Common Sense and Reamer Logic

Why an up-to-date shop that prides itself on modern shop equipment will use a solid reamer and stuff cotton waste, heavy paper or strips of wood on one side of the reamer so as to make it cut a little larger is rather difficult to comprehend. But it is done nevertheless—and in a good many shops, too—possibly in your own shop.

If you use solid reamers, the chances are considerably in favor of your men doing it. But it is a poor method—very poor. It not only severely tries the patience of your men, takes up considerable time and spoils the reamer, but also produces an elliptical hole, poor finish and finally a poor fitting. Then your inspector fumes and kicks, the job is thrown out and probably done all over again—at least it ought to be.

More expense—and all on account of a poor reamer—a solid reamer. The blame probably reverts to the machinist—same old story—innocent suffer always—just because the purchasing department could save a few cents on a solid reamer which soon becomes scrap.

A P. & W. ADJUSTABLE BLADE REAMER Is Exact, can be Kept Exact and Will Last a life-time.

In addition, it can be adjusted a few thousandths larger or smaller to give the exact reaming fit desired.

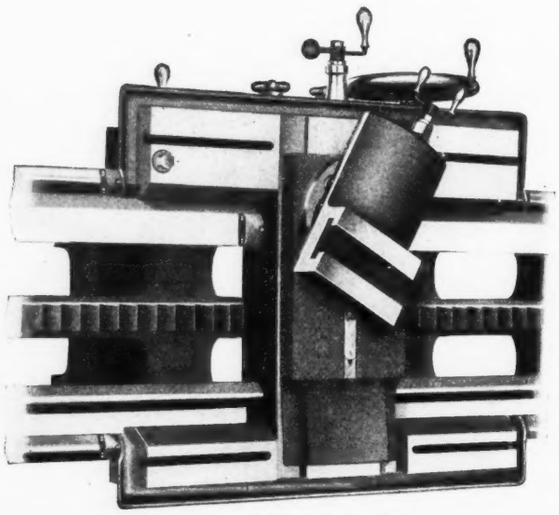
Write for Adjustable Reamer Argument and Catalog "Small Tools".

Hartford, Connecticut, U. S. A.

and Vancouver. London, E.C., Buck & Hickman, Ltd., 2 and 4 Whitechapel Road. London, S. W., Niles-Bement-Pond Co., 23-25 Victoria St. Paris, Fenwick Freres & Co., 8 Rue de Rocroy, Agents for France, Belgium and Switzerland. Japan, F. W. Horne, 70-C Yokohama. Italy, Ing. Ercole Vaghi, Milan. Germany, F. G. Kretschmer & Co., Frankfurt. a. M. Van Rietschoten & Houwens, West Zeedijk 554, Rotterdam, Holland.

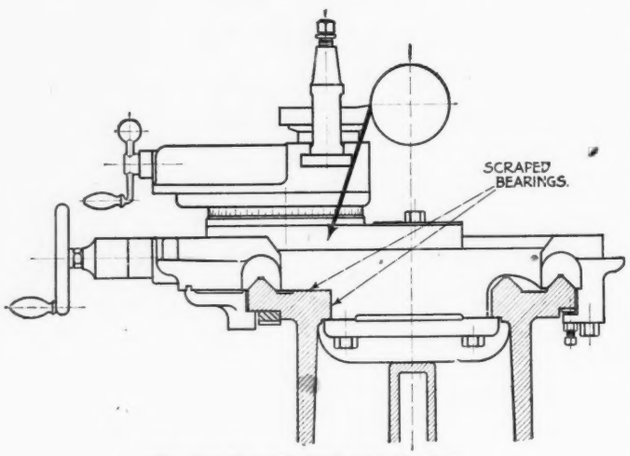
Prevention of Vibration

Vibration in a lathe is objectionable for three reasons—it spoils the accuracy of the work, lessens the life of the lathe, and rapidly batters down the edge of the cutting tool.



Top View of Bed and Carriage.

The bridge of our carriage is designed to prevent such vibration. It is 50 per cent. wider than usual, and correspondingly deep. The most important feature, however, is the supplementary scraped bearing against the horizontal and vertical surfaces of the bed inside the front shear. This bearing supports the bridge directly in line with the tool thrust, and prevents deflection or vibration even under the heaviest cuts.



Section through Bed and Carriage.

The Lodge & Shipley Machine Tool Co.

CINCINNATI, OHIO, U. S. A.

DOMESTIC AGENTS—Brown & Zortman Machinery Co., Pittsburg; Charlotte Supply Co., Charlotte; W. R. Colcord Machinery Co., St. Louis; Dewstoe-Lathrop Machinery Co., Birmingham; Hallidie Machinery Co., Seattle, Spokane; Harron, Rickard & McCone, San Francisco, Los Angeles; J. P. Kemp, Baltimore; Marshall & Huschart Machinery Co., Chicago; Morrison Machinery & Supply Co., Richmond; Motch & Merryweather Machinery Co., Cleveland, Detroit, Cincinnati; C. T. Patterson Co., Ltd., New Orleans; Prentiss Tool & Supply Co., New York, Boston, Buffalo, Syracuse; Robinson, Cary & Sands Co., St. Paul; W. E. Shipley Machinery Co., Philadelphia; Utah Mining Machinery & Supply Co., Salt Lake City, Utah; Vonnegut Hardware Co., Indianapolis; Zimmerman-Wells-Brown Co., Portland.

BETTS MACHINE COMPANY,

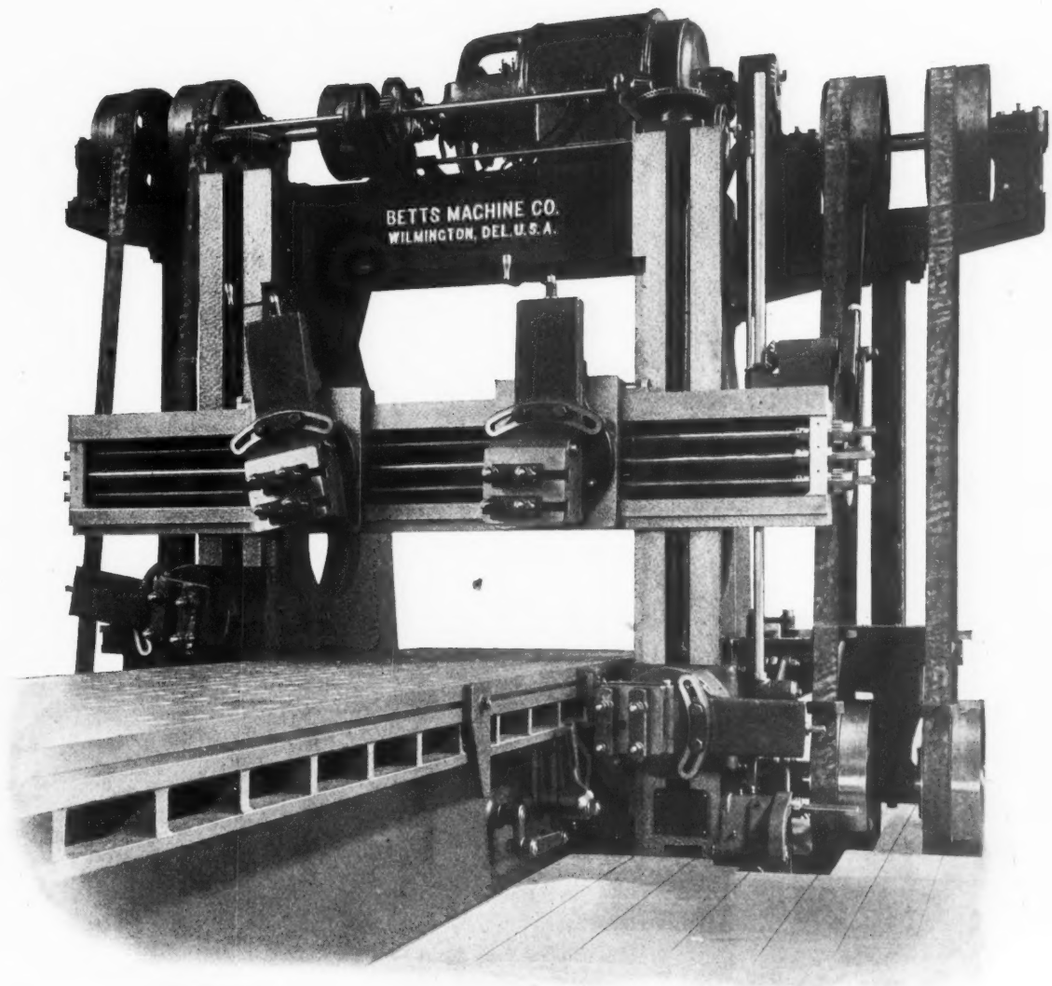
WILMINGTON, DEL., U. S. A.

Makers of

Heavy Machine Tools

FOR

High Speed Steel



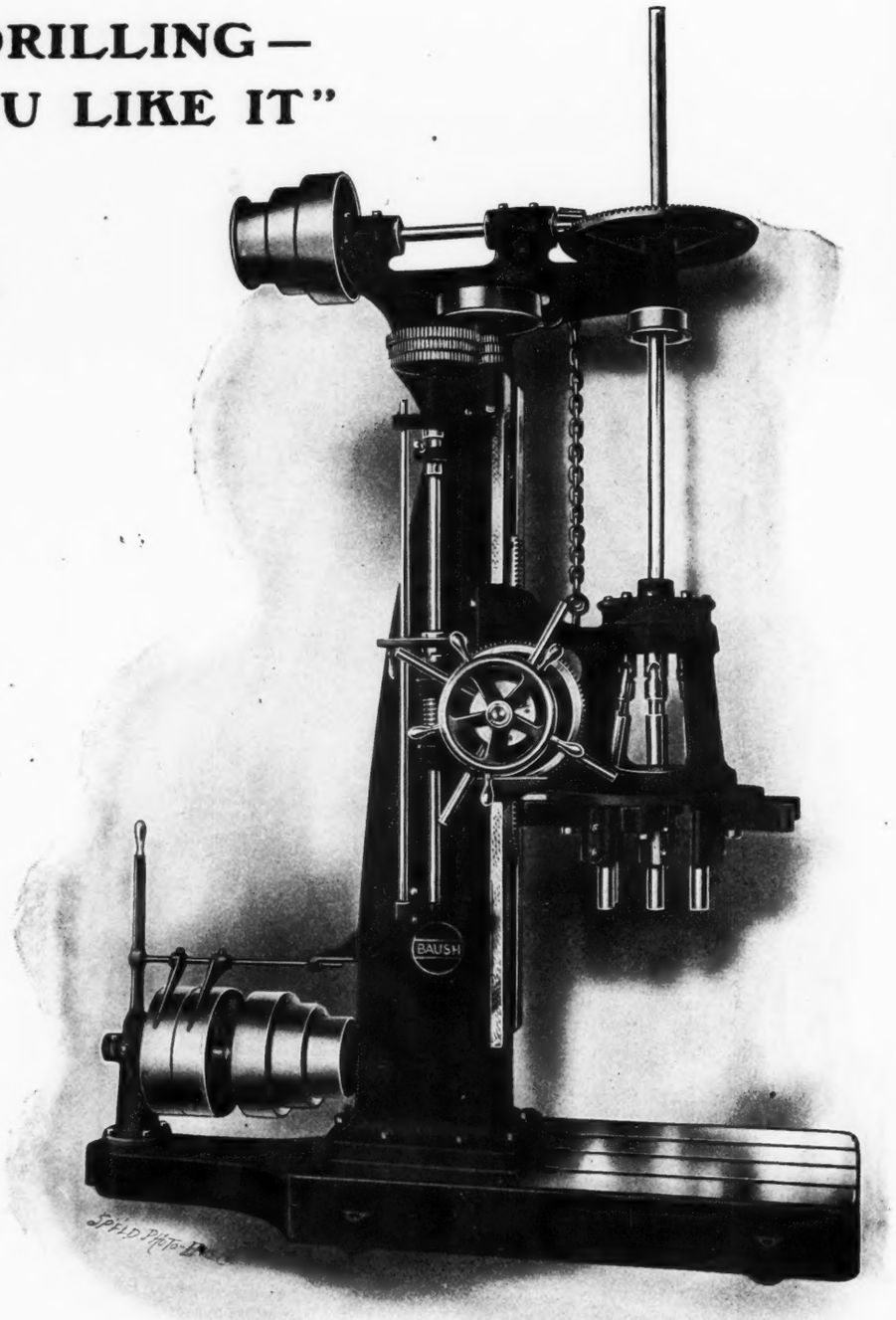
The BETTS Motor Driven 54 Inch Planer, as arranged with FOUR BELT DRIVE for Norfolk and Western Railway Shops, at Roanoke, Va.

Planing Machines, Slotting Machines, Vertical Boring Mills, Horizontal Boring Machines, Tire Mills, Floor Borers, Etc., Etc., Etc.

YOUR DRILLING—"AS YOU LIKE IT"

And 90% Saved in Cost.

Put a Baush Adjustable Multiple Spindle Drill on the Job



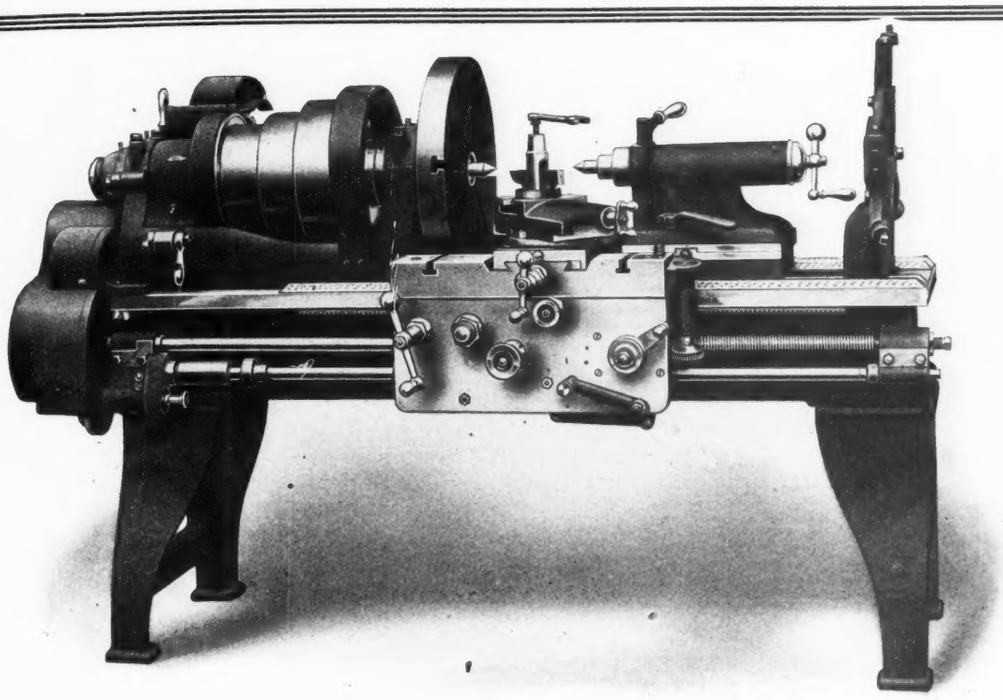
These machines are pioneers for heavy drilling and duplicate work, are built to meet every condition, have enormous power, ample strength and two to twenty-four spindles. They are especially designed for the use of high speed drills, work rapidly and will handle any layout, square, circular or staggered, within the dimensions of the head.

From the economy standpoint, the Baush Drill is indispensable where large numbers of holes are to be drilled—the time-saving alone soon covers the initial cost.

Glad to send details and illustrations.

BAUSH MACHINE TOOL CO., 200 Wason Ave., Springfield, Mass.

AGENTS—Manning, Maxwell & Moore, New York, Chicago, Milwaukee, Boston, Cleveland, Pittsburg, St. Louis, Philadelphia, Detroit, Buffalo, Syracuse, Indianapolis, Atlanta, Yokohama. DeFries & Cie, Dusseldorf. Selson Engineering Co., Ltd., London. Hugo Tillquist, Stockholm. Fenwick Freres & Co., Paris.



18-inch Heavy Pattern Lathe

BRADFORD LATHES LEAD

in Belt Power, High Spindle and Countershaft Speeds, Operating Convenience and Capacity for Heavy Work.

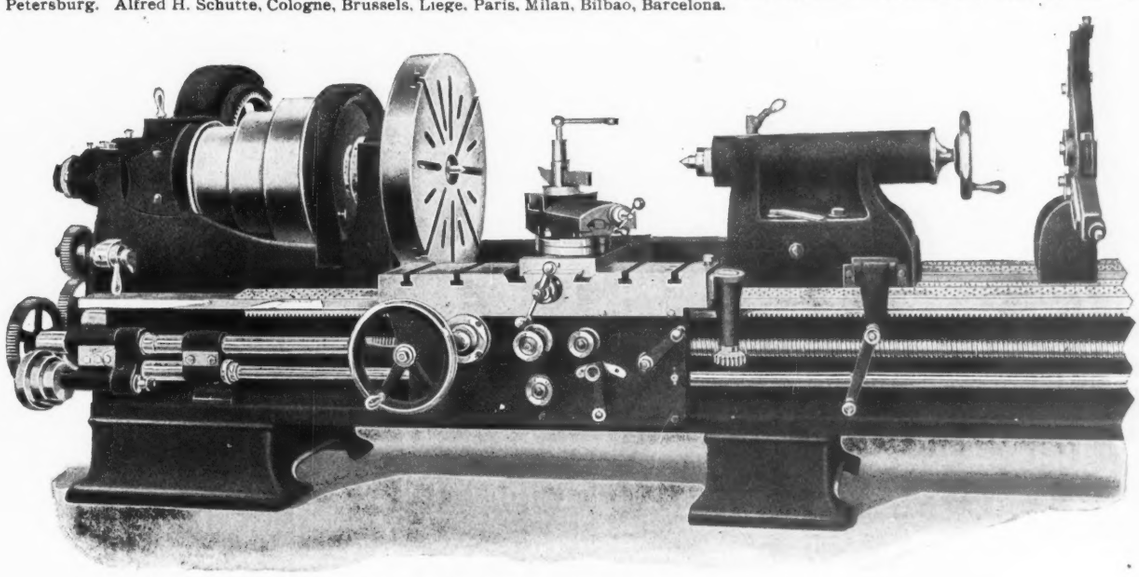
The 18-inch Heavy Pattern Lathe, one of the newest models, is stronger and heavier in every part than the older type, has the simplicity and directness of design that is a Bradford feature, and is equipped with gear feed train entirely separate from the screw cutting train.

The 32-inch Lathe is also one of the improved types. A manufacturing machine with three-step cone, double back gears and power to drive the heaviest cut.

New catalogue and full description on request.

The Bradford Machine Tool Co., Cincinnati, Ohio, U. S. A.

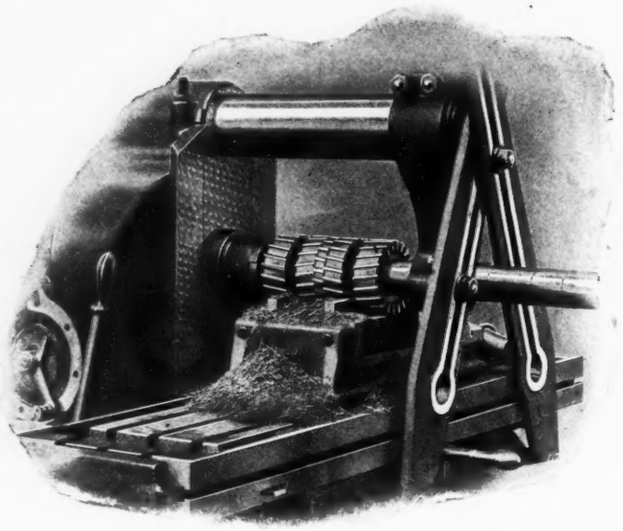
AGENTS—Swind Machinery Co., Philadelphia. Taylor Machinery Co., Boston, Mass. The H. A. Stocker Machinery Co., Chicago, Ill. J. W. Wright & Co., St. Louis, Mo. Somers, Fitler & Todd Co., Pittsburgh, Pa. The Mine & Smelter Supply Co., Denver, Colorado. Pacific Tool and Supply Co., San Francisco, Cal. F. W. Horne, Yokohama, Agent for Japan, China and the Far East. Chas. Churchill & Co., Ltd., London, Birmingham, Glasgow, Newcastle-on-Tyne. Schuchart & Schutte, Berlin, Vienna, Stockholm, Copenhagen, Budapest and St. Petersburg. Alfred H. Schutte, Cologne, Brussels, Liege, Paris, Milan, Bilbao, Barcelona.



32-inch Bradford Lathe

The Unparalleled Rigidity of Construction which Distinguishes Milwaukee Milling Machines

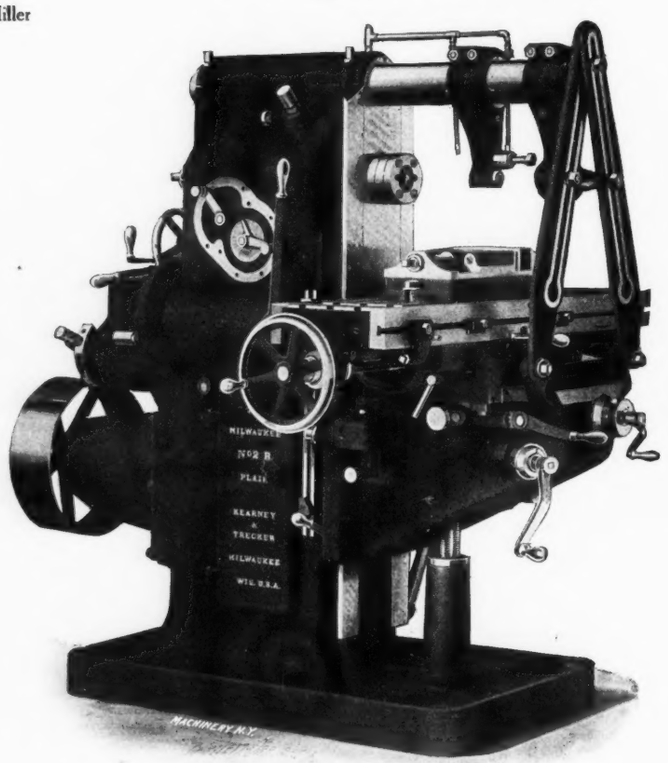
INSURES ACCURATE WORK, PERMANENT ALIGNMENT AND A LONG LIFE TO THE MACHINE



Milling Vise Jaws on a Milwaukee Miller

The column is a box section, cast in one piece and strongly braced with internal ribs; openings in the column are as few and as small as possible and are closed with well fitted plates or brackets. The knee slide of extra width and depth extends up to the over-arm, and the knee itself, of box section form closed at the top, is particularly adapted to withstand torsional and cutting strains. Thickness of metal is proportioned to secure the maximum strength and stiffness, not merely to add weight.

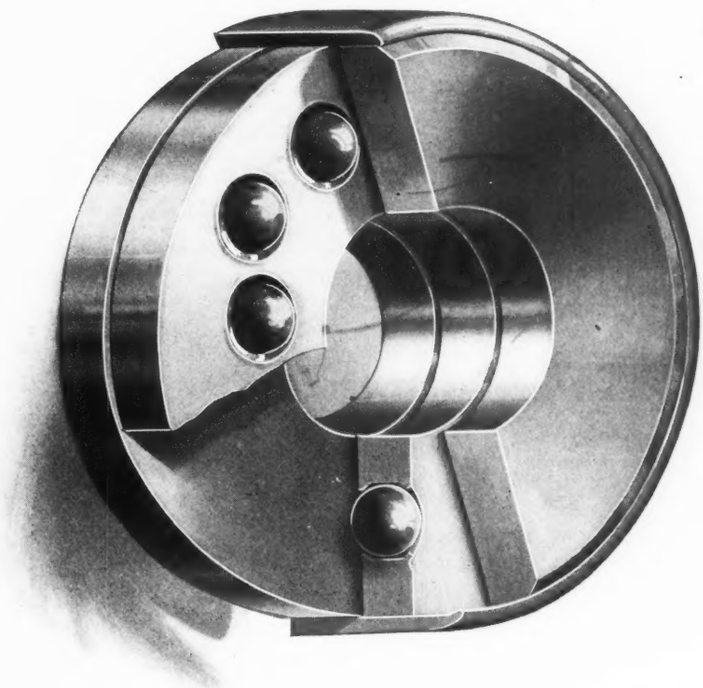
Constant speed drive, the automatic oiling system, simple design and easy operation are also "Milwaukee" features, all of which are fully described in our new catalogue. If you have not seen our latest book, write today for Catalogue No. 17—it's worth while.



Milwaukee Plain Milling Machine

KEARNEY & TRECKER CO., Milwaukee, Wis.

AGENTS: Hill, Clarke & Co., Boston, New York, Philadelphia, Chicago and Cleveland. The A. R. Williams Mchy. Co., Toronto, Ont. Williams & Wilson, Montreal, Quebec. C. W. Burton, Griffiths & Co 1 Ludgate Square, Ludgate Hill, London, England. Heinrich Dreyer, Kaiser Wilhelmstr. 1, Berlin, Germany. Edgar Bloxham, 12 Rue du Delta, Paris, France. R. S. Stokvis & Zonen, Ltd., Rotterdam and Brussels. H. P. Gregory & Co., 74 Clarence Street, Sydney, N S. W. Wilh. Sonesson & Co., Malmo, Sweden. Ing. A. Baldini & Co., Pontedera, Italy.

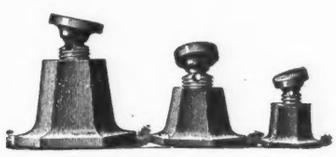


THRUST BALL BEARINGS

MADE TO SUIT YOUR NEEDS

A TIME SAVER IN THE MACHINE SHOP

Leveling Jacks or Adjustable Blocking



FOR SETTING WORK ON THE PLANER AND OTHER MACHINE TOOLS.

THE BINSSE MACHINE COMPANY

NEWARK, NEW JERSEY, U. S. A.

FOREIGN MACHINERY MERCHANTS

BELGIUM

ALFRED H. SCHÜTTE,
5, Vieux-Marche aux Grains, Brussels.
3, Rue de la Cathedrale, Liege.
MACHINERY AND TOOLS.

R. S. STOKVIS & FILS, Soc. An.
1 Boulevard du Jardin Boutanique, Brussels.
MECHANICAL ENGINEERS.
(Rotterdam, Amsterdam and Soerabaya).
Established 1847. Cable "Metallicus."
MACHINERY AND TOOLS.

A. ENGELMANN & CO., Liege.
IMPORTERS AMERICAN MACHINERY, TOOLS AND ENGINES.

FENWICK FRERES & CO.,
68, Rue de Brabant, Brussels.
1, Avenue Blonden, Liege.
AMERICAN MACHINERY AND TOOLS.

CHINA

SCHUCHARDT & SCHÜTTE,
24 Kiangse Road, Shanghai.
MACHINERY AND TOOLS.

DENMARK

SCHUCHARDT & SCHÜTTE,
4, Jernbanegade, Copenhagen.
MACHINERY AND TOOLS.

ENGLAND

RICHARD LLOYD & CO.,
Steelhouse Lane, Birmingham.
IMPORTERS OF AMERICAN MACHINERY, TOOLS AND ENGINEERING SPECIALTIES.
Established 1856. Cable Address, "Cogs," Birmingham. Lieber's and A B C Codes.

ALFRED HERBERT, Ltd., Coventry.
IMPORTERS OF AMERICAN LABOR SAVING TOOLS OF ALL DESCRIPTIONS.
Showrooms: London, Manchester, Glasgow and Coventry. Cable: "Lathe, Coventry." Codes: Lieber's, A B C 5th edition, and private.

BUCK & HICKMAN, Ltd.,
2 and 4 Whitechapel Road, London.
TOOLMAKERS, ENGINEERS AND IMPORTERS of High Class American Machinery, Tools and Supplies. Telegrams and Cables, "Roebuck, London." Lieber's and A B C Codes used.

C. W. BURTON, GRIFFITHS & CO.,
Ludgate Square, Ludgate Hill, London, E. C.
IMPORTERS OF AMERICAN MACHINE TOOLS.
Also at Manchester and Glasgow.
A B C and Lieber's Codes used. Telegrams, "Hibou," London.

CHAS. CHURCHILL & CO., Ltd.,
9 to 15, Leonard St., London, E. C.
THE PIONEERS OF AMERICAN TOOL TRADE IN GREAT BRITAIN.
Established 1865. Large Warehouses in Birmingham, Manchester, Newcastle-on-Tyne, Glasgow. See advertisement in this journal for agencies.

GEORGE HATCH, Ltd.,
20-21, Queenhithe, Upper Thames St., London, E. C.
IMPORTERS OF MACHINE AND HAND TOOLS, ENGINEERING SUPPLIES. SPECIALTY: NEW TOOLS.
Cable, George Hatch, London. Codes, A B C and Lieber's.

C. LINDLEY & CO.,
34, Englefield Road, London, N.
Beauvoir Works, Luddenden, S. O. Yorks.
SMALL TOOLS AND ENGINEERS SUPPLIES.
Telegrams: Beauvoir London and Luddenden.
A B C Code.

LUDW. LOEWE & CO., Ltd.,
30-32 (opposite 109) Farringdon Road, London, E. C.
MERCHANTS AND IMPORTERS OF HIGH CLASS MACHINERY AND TOOLS.
Telegrams and Cables: Loewe London. Lieber's and A B C Codes.

SCHUCHARDT & SCHÜTTE,
34, Victoria St., Westminster, London.
MACHINERY AND TOOLS.

HENRY KELLEY & CO.,
26, Pall Mall, Manchester.
AMERICAN MACHINERY AND TOOLS.
Telegrams: "Advantage, Manchester. "Lieber's Code.

FRANCE

EDGAR BLOXHAM, M. I. E. E.,
Offices and Show-rooms, 12, Rue du Delta, Paris.
IMPORTER OF AND DEALER IN AMERICAN MACHINERY, TOOLS AND SUPPLIES.
Telegrams: Bloxham-Paris. Code: Western Union.
Cash payment against delivery in New York.

PH. BONVILLAIN & E. RONCERAY,
Main Office: 9-11, Rue des Envierges, Paris.
ENGINEERS. IMPORTERS OF AMERICAN TOOLS.
Branches: Dusseldorf-Rath-Germany. Turin, 48 Via Sacchi, Italy; Leeds, Albion Works, England; Barcelona, Concejo de Ciento, Spain. Cable: Bonvillain, Paris. Lieber's and A B C Codes.

FENWICK FRERES & CO.,
8, Rue de Rocroy, Paris.
AMERICAN MACHINERY AND TOOLS.
Branches or Representatives: Brussels, Liege, Turin Milan, Zurich and Barcelona.

FRANCE

GLAENZER, PERREAUD & THOMINE,
18-20, Faubourg du Temple, Paris.
IMPORTERS OF AMERICAN MACHINERY
and Mechanical Supplies. Agent for the Niles Tool Works Co., Geo. F. Blake Mfg. Co., etc. Lieber's Code, AL Code, A B C Code. Cable Address: Blakeniles, Paris. New York Office: 43-47 West 33rd St.

ALFRED HERBERT (France), Ltd.,
47, Boulevard de Magenta, Paris.
IMPORTERS OF AMERICAN LABOR SAVING TOOLS OF ALL DESCRIPTIONS.
Cable: "Hexagon, Paris." Codes: Lieber's, A B C 5th edition and private.

ALFRED H. SCHÜTTE,
22-24, Rue des Pettis-Hotels, Paris.
MACHINERY AND TOOLS.

GERMANY

HEINRICH DREYER,
Kaiser Wilhelmstr. 1, Berlin.
IMPORTER AMERICAN MACHINERY.
Telegrams: "Firstclass."

ALFRED HERBERT, Ltd.,
Potsdamer Strasse, 60, Berlin.
IMPORTERS OF AMERICAN LABOR SAVING TOOLS OF ALL DESCRIPTIONS.
Cable: "Capstan." A. B. C. Code.

LUDW. LOEWE & CO., A.G., Berlin, N.W. 87.
IMPORTERS OF MACHINE TOOLS.
To be seen in operation at our works. Floor area 13 acres.

HANS RICHTER & KITZEROW, Berlin, S. 42.
IMPORTERS OF AMERICAN MACHINERY AND TOOLS.
Telegrams: Impulsus. Lieber's and A B C Codes.

SCHUCHARDT & SCHÜTTE,
IMPORTERS OF MACHINE TOOLS.
Berlin, Vienna, Budapest, Shanghai, Tokio, London, Stockholm, Copenhagen, St. Petersburg.
New York Office: 90 West Street.

E. SONNENTHAL, Jr., Berlin-Cologne-Vienna.
IMPORTER OF AMERICAN MACHINERY AND SMALL TOOLS.

ALFRED H. SCHÜTTE, Cologne.
MACHINERY AND TOOLS.
Brussels, Liege, Belgium; Paris, France; Milan, Turin, Genoa, Italy; Barcelona, Bilbao, Spain.
New York Office: 90 West Street.

FRANZ KÜSTNER, Dresden, N.
AMERICAN MACHINERY TOOLS AND SUPPLIES.
Cable: Ambition-Dresden. Lieber's and A B C Codes.

DE FRIES & CIE, Akt. Ges., Dusseldorf.
Berlin, Stuttgart, Vienna, Paris, Milan, Barcelona.
IMPORTERS OF AMERICAN MACHINE TOOLS.
Cable Address: Defries, Dusseldorf; Lieber's; A B C, 5th edition; Western Union Codes.

M. KOYEMANN, Dusseldorf.
IMPORTER OF AMERICAN MACHINE TOOLS.

CARL MAHR, Esslingen o/Neckar.
APPLIANCES FOR MECHANICAL WORK SHOPS.

F. G. KRETSCHMER & CO., Frankfurt a/Main.
IMPORTERS AMERICAN MACHINE TOOLS.
Cable: "Micrometer Frankfurtmain." Lieber's and A B C Codes.

VOGEL & SCHEMMANN,
Kabel-Hagen-Westphalia.
IMPORTERS OF AMERICAN MACHINERY AND SMALL TOOLS.

HOLLAND

Ls: N. ALTA & CO., Amsterdam.
ENGINEERS AND IMPORTERS OF MACHINERY.

PECK & COMPANY, Amsterdam.
IMPORTERS OF AMERICAN MACHINERY.
Tools. Factory Supplies. Lieber's and A B C Codes.

FRED. STIELTJES & CO., Amsterdam.
ENGINEERS AND IMPORTERS OF AMERICAN MACHINERY.

H. G. AIKEMA & CO., Rotterdam.
ENGINEERING AGENTS AND MERCHANTS.
Importers of American Machinery and Tools.

R. S. STOKVIS & ZONEN, Ltd.
MECHANICAL ENGINEERS, TECHNICAL DEPARTMENT II.
Rotterdam (Amsterdam, Brussels and Soerabaya).
Established 1847. Cable: "Metallicus."
MACHINERY AND TOOLS.

SPLIETHOFF, BEEUWKES & CO., Rotterdam.
ENGINEERING AGENTS AND MERCHANTS.

WYNMALEN & HAUSMANN, Rotterdam.
ENGINEERING AGENTS AND MERCHANTS.
Glashaven, 4-14. Established 1875. Special Tools, Metal and Wood Working Machinery.

HOLLAND

VAN RIETSCHOTEN & HOUWENS,
West Zeedyk, 554, Rotterdam.
LARGEST DEALERS IN AMERICAN MACHINERY in Holland. New showroom, 11,000 sq. feet, now open.
Cable: "Machinery." Codes used: A B C, 5th edition; Lieber's.

AUSTRIA-HUNGARY

CONRAD & COMP, Budapest.
AMERICAN MACHINERY, TOOLS AND SUPPLIES.

SCHUCHARDT & SCHÜTTE,
Vienna, I, Franz Joseph Quai 7-9.
Budapest, terez körut 46.

DONAUWERK ERNST KRAUSE & CO.,
Vienna, XX, 2 Engerthstrasse 165.
AMERICAN MACHINERY AND TOOLS.
Cables: Donauwerk, Vienna Lieber's Code.

ITALY

GRIMALDI & C., Casella 320, Genova.
AMERICAN MACHINERY AGENTS.
Branch House in Milan, Italy.

DE FRIES & CO.,
Via Principe Umberto Angolo Via Moscova, Milan
IMPORTERS AMERICAN MACHINERY AND TOOLS

ALFRED HERBERT, Ltd., Milan.
19 Via Pontaccio.
IMPORTERS OF AMERICAN LABOR SAVING TOOLS OF ALL DESCRIPTIONS.
Cable: "Herbert, Milan." Codes: Lieber's, A B C 5th edition, and private.

ALFRED H. SCHÜTTE,
Viale Venezia, 22, Milan. Via Alfieri. 4, Turin.
MACHINERY AND TOOLS.

STÜSSI & ZWEIFEL, Via Dante 8, Milan.
IMPORTERS OF AMERICAN MACHINERY.

ING. ERCOLE VAGHI,
MACHINE TOOLS. Corso Porta Nuova 34, Milan.

W. VOGEL, Piazza Castello 3, Milan.
AGENT FOR AMERICAN MACHINERY.

INGR. A. BALDINI & CI. Pontedera.
IMPORTERS OF AMERICAN MACHINES AND TOOLS.
Telegrams: Macchine, Pontedera. Codes: Lieber's and A B C 5th edition.

FENWICK FRERES & CO.,
6 Via Lagrange, Turin.
AMERICAN MACHINERY AND TOOLS.

JAPAN

ALFRED HERBERT, Ltd.,
224, Yamashita-Cho, Yokohama.
IMPORTERS OF AMERICAN LABOR SAVING TOOLS OF ALL DESCRIPTIONS.
Cable: "Lathe, Yokohama." Codes: Lieber's, A B C 5th edition, and private.

SCHUCHARDT & SCHÜTTE,
14, Akashicho Tsukyi, Tokio.
MACHINERY AND TOOLS.

RUSSIA

SCHUCHARDT & SCHÜTTE,
Newsky Prospect 11, St. Petersburg.
MACHINERY AND TOOLS.

GRÉGOIRE WEINBERG & CO., Eng'rs,
Newsky Prospect, 47-1 St. Petersburg.
MACHINERY, TOOLS, HYDRAULIC MACHINERY.
Cranes and Gas Engines. Cable Address: "Greweco."

SPAIN

ALFRED H. SCHÜTTE,
Calle Lauria 18, Barcelona.
Gran Via 29, Bilbao.
MACHINERY AND TOOLS.

LA MAQUINARIA ANGLO-AMERICANA,
R. d'Aulignac. Cortes 559—Barcelona.
MACHINERY, TOOLS AND SUPPLIES.

SWEDEN

SAM LAGERLOF'S MACHINE-BUREAU, Stockholm.
SPECIALTY: MACHINE TOOLS.
Cable: "Machinlagerlof." A B C and Lieber's Code.

SCHUCHARDT & SCHÜTTE,
Vasagatan N. R. 24, Stockholm.
MACHINERY AND TOOLS.

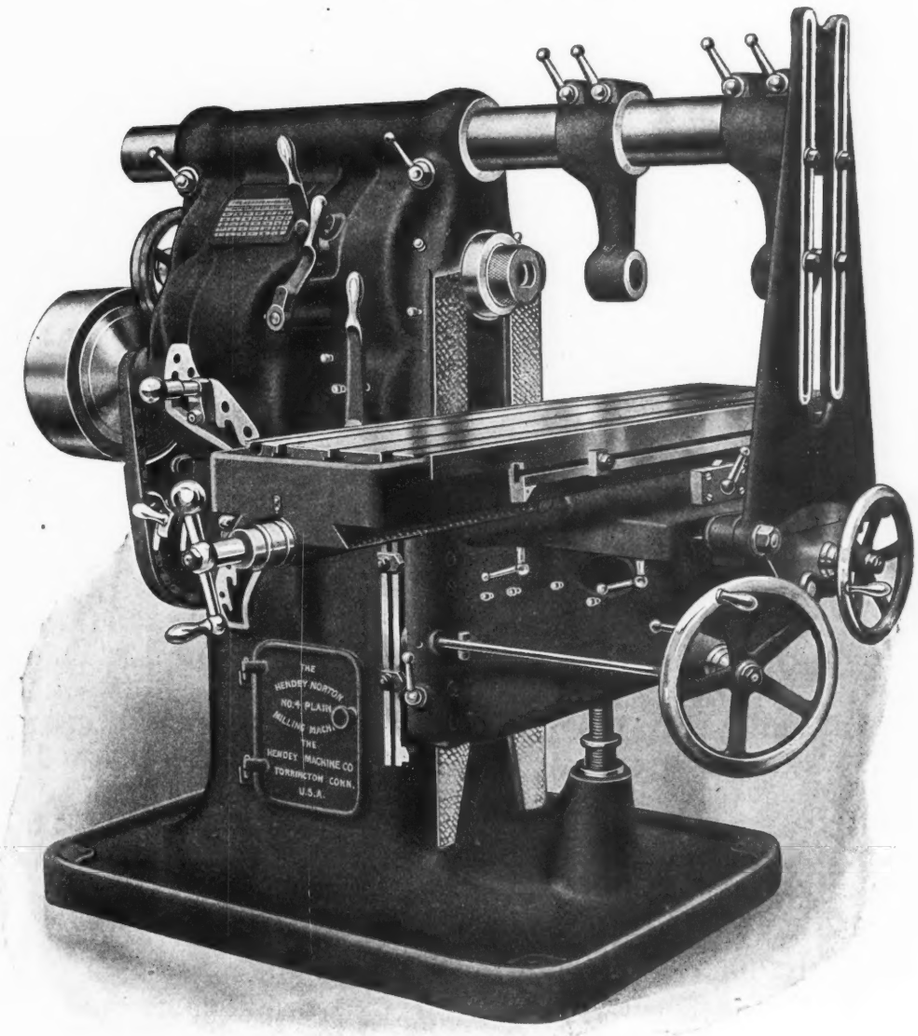
SWITZERLAND

J. LAMBERCIER & CIE, Geneva.
IMPORTERS OF AMERICAN MACHINERY.
Technical Appliances.

SPOERRI & CO., Bergstrasse 76, Zurich.
ENGINEERS AND IMPORTERS OF MACHINERY.

THE AMERICAN MACHINERY IMPORT OFFICE, 24, Weinbergstrasse, Zurich.

Hendey No. 4 Geared Spindle Plain Milling Machine



Machine has fifteen mechanical spindle speeds. Five of these range through the gear cone on spindle, the remaining ten through the medium of double back gears; all in geometric progression, running from 12 to 350 r. p. m.

To make these changes you operate one rocker gear lever and two clutch levers with right and left settings. Perfectly simple, nothing complicated.

There are twenty-one feed changes with travel of ¼″ to 25″ per minute irrespective of spindle speeds. Two gear box latched levers control all variations of feeds.

Power feed in all directions with a range of 42″ x 12″ x 20″. All feed engagements made from front of machine without changing position.

Driving pulley engages with power shaft through expanding ring clutch, facilitating gear changes. Pulley 16″ diameter. Belt 5″ wide.

Ball bearings on elevating and table feed screws.

Main Spindle has taper journals with independent adjustment and oiling rings lubricating both bearings.

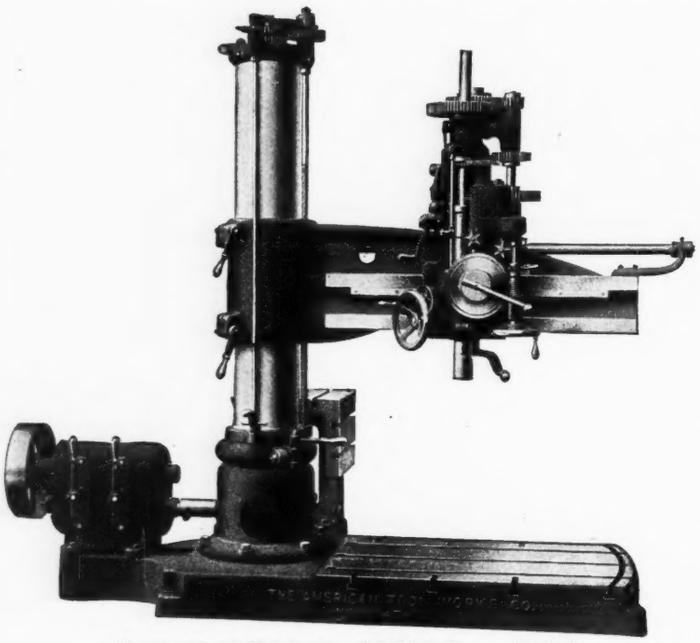
Machine fully described in folder.

The Hendey Machine Co., Torrington, Conn.

AGENTS: Manning, Maxwell & Moore, Inc., New York, Boston, Philadelphia, Pittsburg, Chicago, Detroit, Buffalo, Cleveland, Indianapolis, St. Louis, Milwaukee. Schuchardt & Schutte Berlin. C. W. Burton, Griffiths & Co., London, England. J. E. Chabert & Co., Paris, France. Ing. Ercole Vaghi & Co., Milan, Italy.

There is Really a Wonderful Difference in Radial Drills

Many men have learned this fact thru a visit to our works where they have tested our Radials.



4'—5'—6'—7' Triple Geared High Power Radials
Belt or Motor Drive

The Drill you want for your work is the one which will do that work in the least possible time and with the greatest accuracy. If your drills are not doing this, YOU ARE LOSING MONEY.

Investigate the "AMERICAN" RADIAL.

These drills, without exception, hold all records for rapid and accurate drilling and tapping on standard radials. In the tapping attachment are used our Patented Double Band Frictions, consisting of an inner expanding ring and an outer contracting ring all in one, which give a far greater area of frictional contact than is possible to obtain with any other type of friction of similar dimensions.

Our Radials afford a *generous* range of spindle speeds and the improved feeding mechanism provides a sufficient range of feeds for all classes of work.

THINK OF IT—Our 4′ Radial pulls a 6″ pipe tap and our 6 Radial pulls an 8″ pipe tap.

IS THIS NOT SUFFICIENT PROOF OF THEIR POWER?

There are many other excellent points about these machines which our literature describes in detail. Write for this and familiarize yourself with the true quality of our machines.

If you cannot come to Cincinnati to examine our radials, notify us, as we have hundreds running in all parts of the world.

The better acquainted you become with "American" Radial Drills, the more enthusiastic you will be about them.

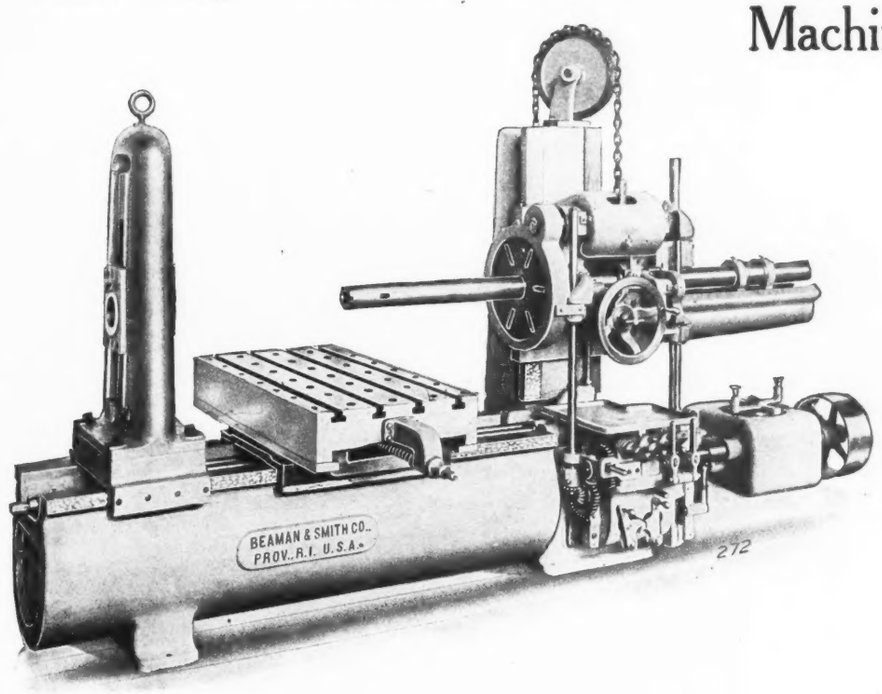
Write today—Don't wait.

THE AMERICAN TOOL WORKS COMPANY

CINCINNATI, U. S. A.

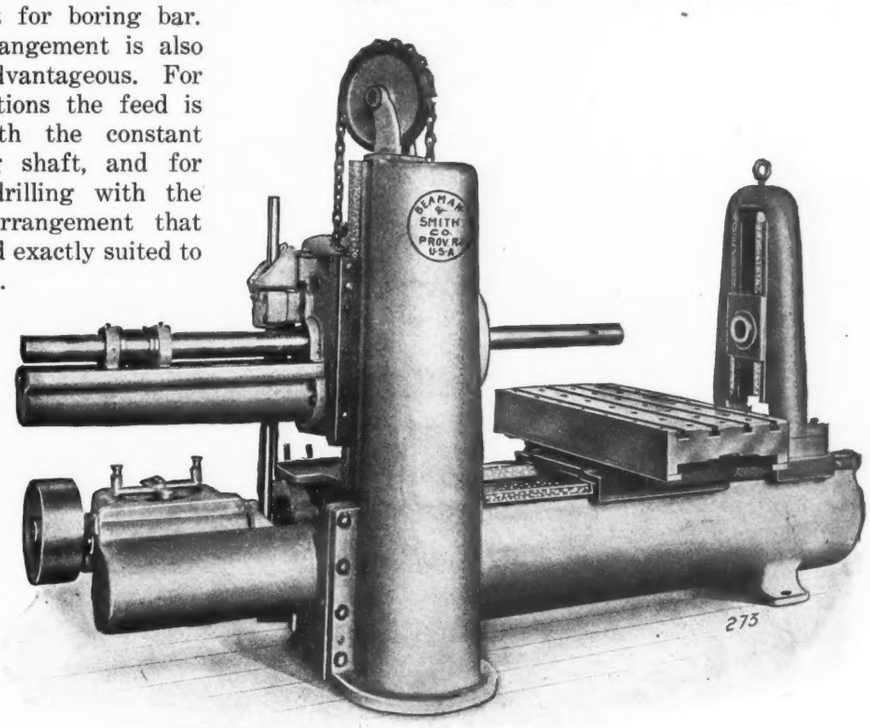
LATHES PLANERS SHAPERS RADIAL DRILLS

New Type Beaman & Smith Boring and Milling Machine No. 10



Front View No. 10 Machine.

Among improvements in the design of this machine are the Cylindrical form for bed and column which most effectually resists the strains consequent to heavy work, Longitudinal Cross Movement of the well supported table, Counterbalanced head and Outer support for boring bar. The feed arrangement is also particularly advantageous. For milling operations the feed is connected with the constant speed driving shaft, and for boring and drilling with the spindle—an arrangement that permits a feed exactly suited to each operation.



Back View No. 10 Machine.

Ask for Circular No. 22 with specifications.

THE BEAMAN & SMITH CO, Providence, R. I., U. S. A.

AGENTS—Chas. Churchill & Co., London, Eng. Fenwick Freres & Co., Paris, France. Ludw. Loewe & Co., Berlin, Germany.

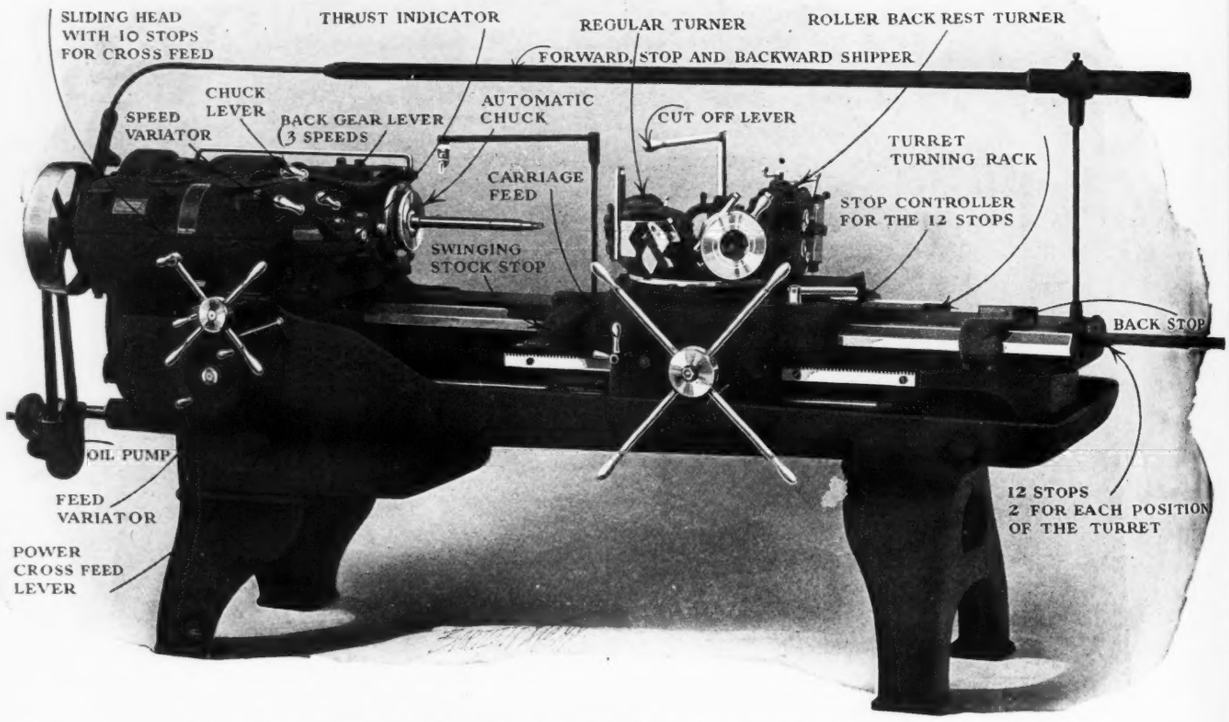
Are You Ready For Orders?

How many orders have you had to refuse because of the incapacity of your Lathes to turn them out properly?

Profits are made by getting out work when *wanted* and *as* wanted. Your capacity for machining certain parts might often get you a big order. For lack of the proper tools—you lose it.

Notice the difference—in detail—between ordinary "capable-of-doing-*some*-work" lathes, and the "capacity-for-all-kinds-of-work" machine, the

FLAT TURRET LATHE



The FLAT TURRET LATHE has all the merits of similar machines with advantages peculiarly and exclusively its own.

Improvement after improvement has been introduced until it is close to the acme of lathe perfection.

This "specialized" machine is conveniently operated, has lightness and strength combined, and gives accurate results quickly. Equally efficient for bar or chuck work.

Springfield, Vermont, U. S. A. **Jones & Lamson**

Germany, Holland, Belgium, Switzerland, Austria-Hungary, M. Koyemann, Charlottenstrasse112, Dusseldorf, Germany.

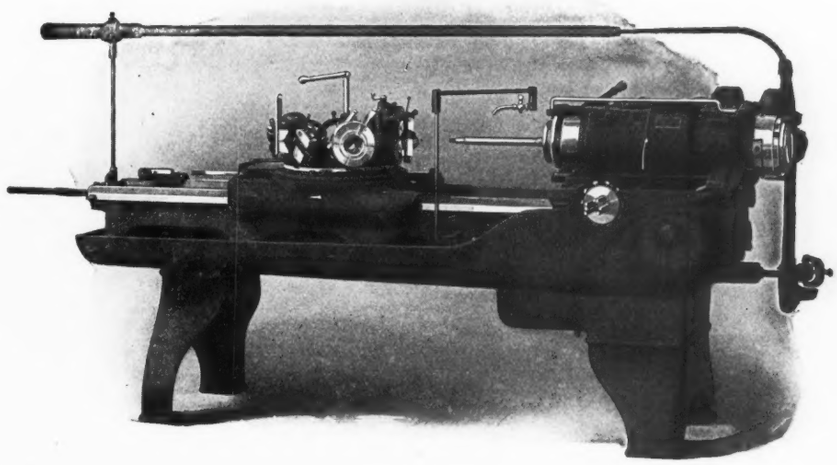
THE FLAT TURRET LATHE

is adaptable to all present and anticipates future needs.

It has a quick re-setting scheme for change of tools to exact position, saving much time and labor and, consequently, money.

Its single slide principle assures most accurate, powerful and convenient control of work and tools.

Change in the line of work can be easily and quickly effected—and a change back again just as easily.



It requires no special tools. Its own are of the adaptable kind and always ready for any class of work.

In the precision of its stop mechanism it is unequaled.

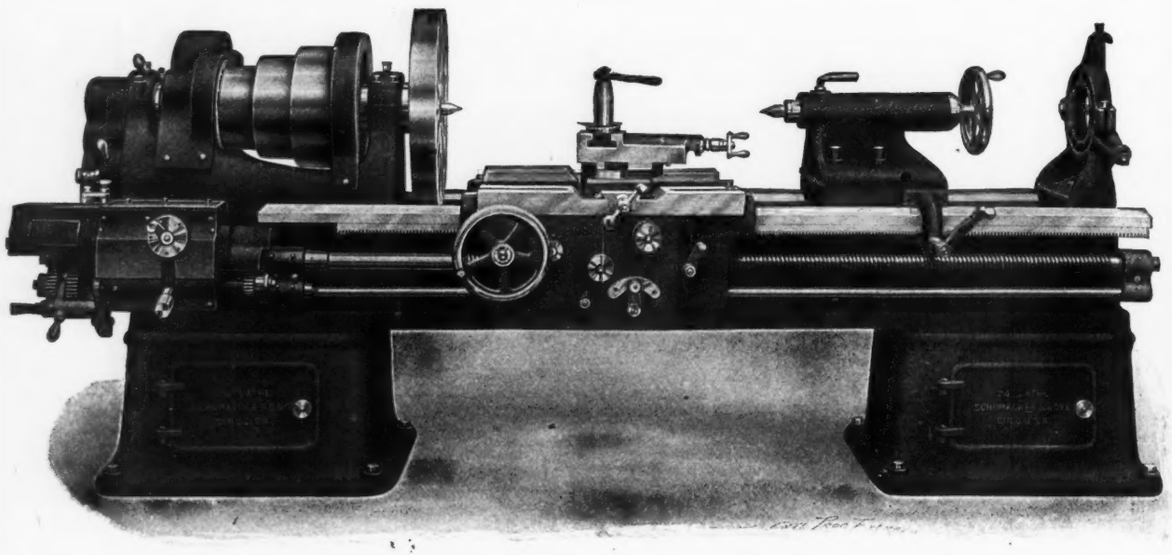
The ease with which the cutting tools can be re-set practically doubles the cutting speed, which means doubling the output of man and machine.

Lightness of design, rigid strength and extreme serviceability are three of its conspicuous merits.

"Fifty-five years the leader and still in front."

Machine Company Queen Victoria St., London, E. C.

France and Spain, Ph. Bonvillain and E. Ronceray, 9 and 11 Rue des Envierges, Paris. Italy, Adler & Eisenschitz, Milan.



Twenty-four Inch Instantaneous Change Gear Engine Lathe
Double Back Geared Double Plate Apron

SCHUMACHER & BOYE

Engine Lathes, 18″ to 48″ Swing **CINCINNATI, OHIO, U. S. A.**

DOMESTIC AGENTS—Manning, Maxwell & Moore, New York City, Chicago, Milwaukee, Boston, San Francisco, Cal., Buffalo, St. Louis, Atlanta, Philadelphia, Indianapolis. The Baird Machinery Co., Pittsburg, Pa. The Strong, Carlisle & Hammond Co., Cleveland, Ohio, and Detroit, Mich. Henshaw, Bulkley & Co., San Francisco, Cal. The Pacific Coast Mfg. Co., Los Angeles, Cal. The Perine Machinery Co., Seattle, Wash. Inland Machinery and Engineering Co., Spokane, Wash. Kellogg & Co., Toronto, Ont.

Simplicity is an Oesterlein Attribute

Complicated, power consuming designs have no place in Oesterlein machines; they are built to produce first class manufacturing results, quickly and economically, in the hands of the average workman and to save operating and maintenance expense.

Experience is built into each machine—experience that considers not only simplicity but convenience of operation, strength for long wear and rigidity for bearing heavy strains.

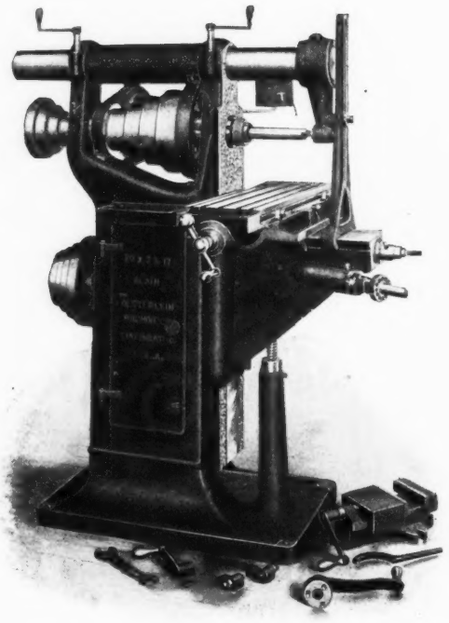
Particularly adapted for requirements of the general shop and manufacturing needs.

Plain and Universal Machines.
Let us send circulars.

The Oesterlein Machine Company

Cincinnati, Ohio, U. S. A.

AGENTS.—Hill, Clarke & Co., Boston, Chicago, New York, Philadelphia and Cleveland. M. I. Hibbler Machine Supply Co., Rochester. Mine & Smelter Supply Co., Denver. Fairbanks Co., Pittsburg and Buffalo. Compressed Air Machinery Co., San Francisco. Pacific Coast Mfg. Co., Los Angeles. Kellogg & Co., Toronto. E. Sonnenthal, Jr., Berlin, Cologne, Vienna and Frankfort A/M.



No. 20 Plain Milling Machine.

New Style 48-inch Cincinnati Forge Planer

The Heaviest and most Powerful 48-inch Planer on the market.

This machine has fully as much weight and power as the ordinary 60-inch planer and is designed for the hardest service and the heaviest classes of work. In building the planer cast iron parts have been replaced by steel, and forgings substituted for steel castings. The Double Drive is another advantage—giving double the power, doubling production and putting the machine in the lead among high-grade, high speed planers.

The 48-inch Cincinnati is of the variable speed type, with speed changes from 15′ to 50′ per minute under instant control of the operator and has all the convenient and labor saving devices for which Cincinnati Planers are famous.

We shall be glad to forward Catalogue or special description of this machine.

Cincinnati Planer Co., Cincinnati, Ohio

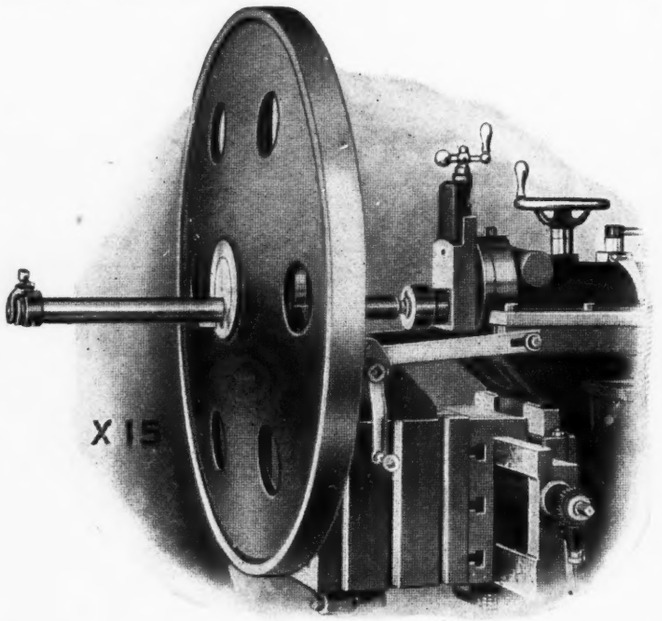
DOMESTIC AGENTS—Prentiss Tool & Supply Co., New York, Syracuse, Buffalo, Rochester and Boston. Marshall & Huschart Mchy. Co., Chicago, Milwaukee, St. Louis and Indianapolis. Motch & Merryweather Mchy Co., Cleveland, Cincinnati and Detroit. W. E. Shipley Mchy. Co., Philadelphia, Pa. Baird Mchy. Co., Pittsburg, Pa. Harron, Rickard & McCone, San Francisco and Los Angeles, Cal. Hallidie Mchy. Co., Seattle and Spokane. Robinson, Cary & Sands Co., St. Paul and Duluth. Zimmerman, Wells, Brown Co., Portland, Oregon. Galligher Mchy. Co., Salt Lake City. Dewstoe-Lathrop Mchy. Co., Birmingham, Ala. Morrison Mchy. & Supply Co., Richmond, Va. J. P. Kemp, Baltimore, Md.

FOREIGN AGENTS—Ludw. Loewe & Co., Berlin. R. S. Stokvis & Zonen. Rotterdam, Holland & Brussels, Belgium. J. Lambercier & Co., Geneva, Switzerland. Ing. Ercole Vaghi, Milan. Donauwerk Ernst Krause & Co., Vienna, Austria. Andrews & George, Yokohama, Japan. Thos. McPherson & Son, Melbourne, Australia.

"Cincinnati" Heavy Duty Shapers

ARE MADE WITH CARE

WITH OUR KEYWAY CUTTING ATTACHMENT you are not limited in size of gears to be key-seated. It key-seats large gears as well as small and both equally well, and you have a shaper to use when there is no key-seating to be done.



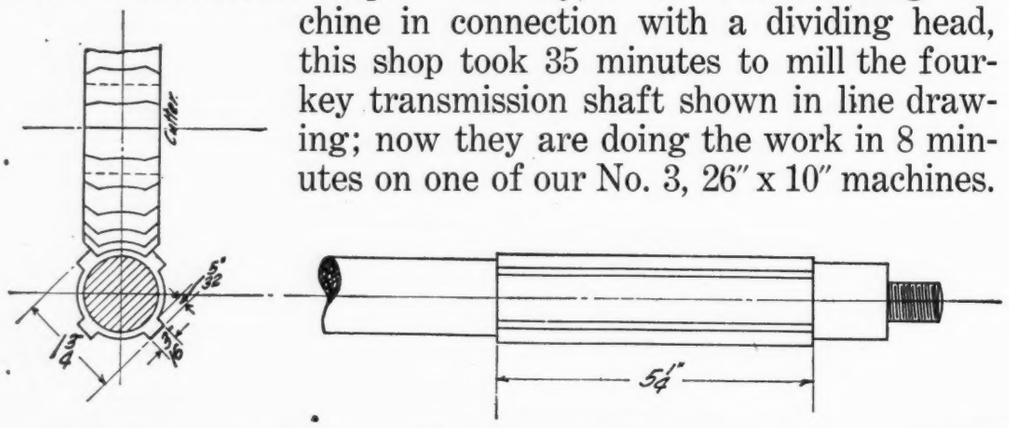
The Cincinnati Shaper Co., Cincinnati, Ohio, U.S.A.

AGENTS—Manning, Maxwell & Moore, Inc., New York, Philadelphia, Chicago, Boston, St. Louis, Syracuse, Detroit, Cleveland, Atlanta, Buffalo, Milwaukee, Indianapolis and Mexico City. Brown & Zortman Machinery Co., Pittsburgh. The National Supply Co., Toledo, O. Eccles & Smith Co., San Francisco, Cal. Smith, Booth, Usher Co., Los Angeles, Cal. Hallidie Machinery Co., Seattle, Wash. Zimmerman, Wells, Brown & Co., Portland, Oregon. C. T. Patterson Co., Ltd., New Orleans, La. Chas. Churchill & Co., Ltd., London, Birmingham, Manchester, Newcastle-on-Tyne, Glasgow. A H. Schutte, Brussels, Cologne, Bilbao, Paris, Liege, Milan. Schuchardt & Schutte, St. Petersburg, Berlin, Copenhagen, Stockholm. Donauwerk Ernst Krause & Co., Vienna, Prague and Budapest. H. W. Petrie, Ltd., Toronto, Montreal and Vancouver. Thos. McPherson & Son, Melbourne. Andrews & George, Yokohama.

THAT THE

"Cincinnati" Spur Gear Cutters

excel others in power is demonstrated by the work being done in a contract shop. Formerly, on a modern milling machine in connection with a dividing head, this shop took 35 minutes to mill the four-key transmission shaft shown in line drawing; now they are doing the work in 8 minutes on one of our No. 3, 26″ x 10″ machines.

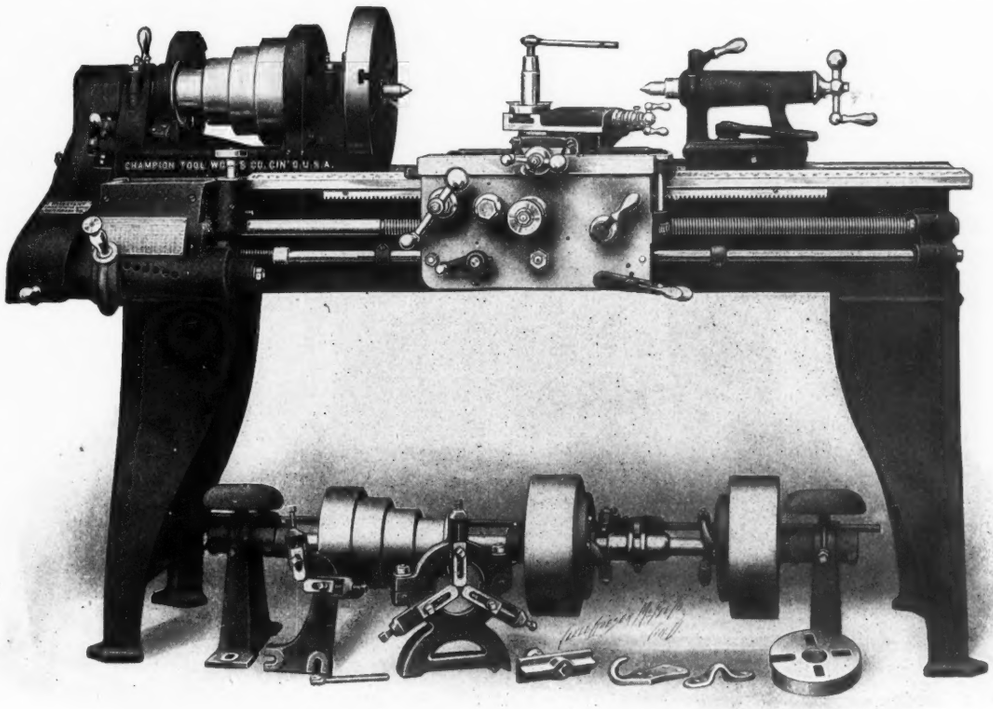


The Cincinnati Gear Cutting Machine Co., CINCINNATI, OHIO, U.S.A.

Manning, Maxwell & Moore, Inc., New York, Boston, Chicago, Philadelphia, Pittsburgh, St. Louis, Cleveland, Syracuse, Atlanta, Buffalo, Mexico City, Milwaukee and Detroit, Agents.

CHAMPION

12-IN. QUICK CHANGE GEAR ENGINE LATHE



For factory or tool room purposes is not surpassed, and is of that type of rigid construction which admits of the use of high speed cutting steels. The accuracy of the lathe is of the highest character.

IMPORTANT: There are not a few 10-inch lathes manufactured to swing 12 inches, and some 12-inch lathes to swing 14-15 and 16 inches, but do not get our **Standard 12-inch Lathe,** which swings 13⅛ inches, confounded with these tools, as they may be offered you as 11-12-13-14-15 and 16-inch lathes, when in reality they are only standard 10 and 12-inch lathes.

The Automatic Stop to longitudinal feed on the Champion Quick Change Lathes operates in either direction, and the screw and rod feeds cannot be engaged at the same time. The feed reverses from the apron, and with the **chasing dial** on carriage the operator can catch threads instantly without having to return the carriage by reversing the countershaft or stopping the lathe.

40 changes of feed and threads without the removal of a gear, including 11½ and all standard threads from 2 to 56 per inch. Feeds are 3½ times the threads. All changes made while the lathe is running, and every gear is covered.

Remember the **Champion does it quicker and better.**

Write for our printed descriptions.

5 sizes: 10, 12, 14, 16 and 18-inch Swing.

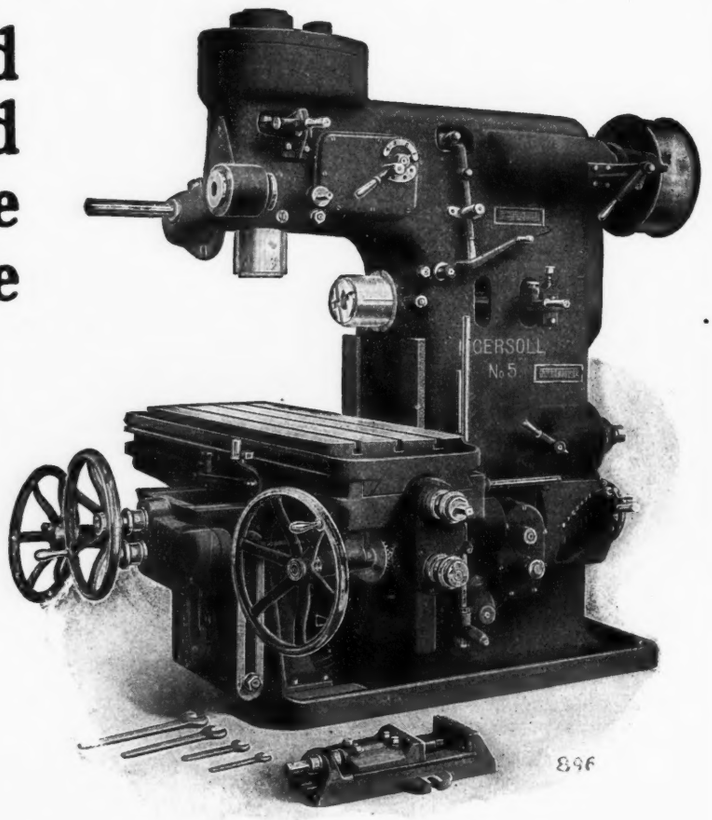
CHAMPION TOOL WORKS COMPANY

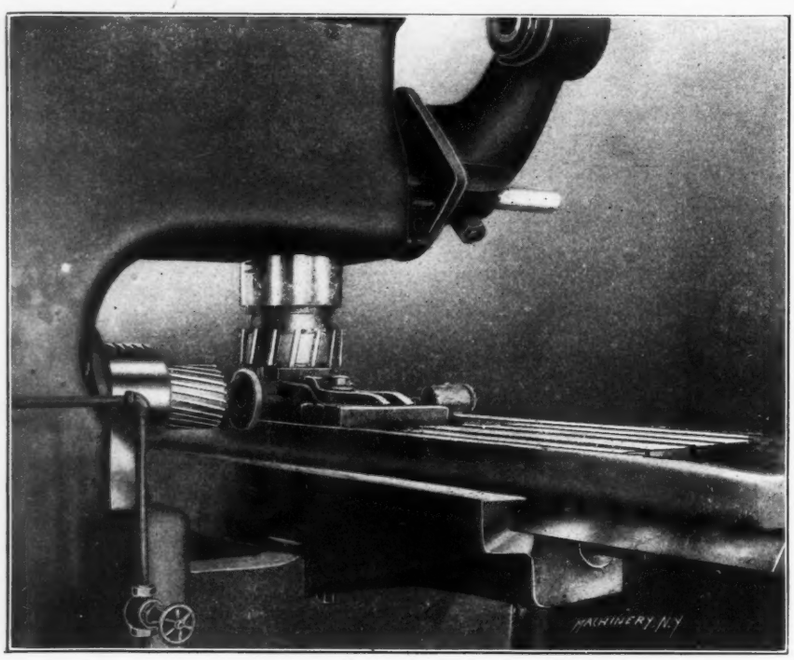
2422 SPRING GROVE AVENUE, CINCINNATI, OHIO

THE NEW INGERSOLL MILLER

The Combined Horizontal and Vertical Spindle Milling Machine

is a manufacturing plant in itself. Combines all the advantages of both horizontal and vertical types in one machine—saves floor space, operating force. At the expense of one machine, covers a range of work equal to two machines and has strength and power for the heaviest cuts, either vertical or horizontal, or **with both spindles working in unison.**





The advantage of the Combination Miller, with both spindles in operation, is shown in the engraving, which tells the story better than words.

We build Milling Machines exclusively, every type, every combination of spindles, every size.

Full descriptions in the Catalogue.

The Ingersoll Milling Machine Co.

ROCKFORD, ILLINOIS, U. S. A.

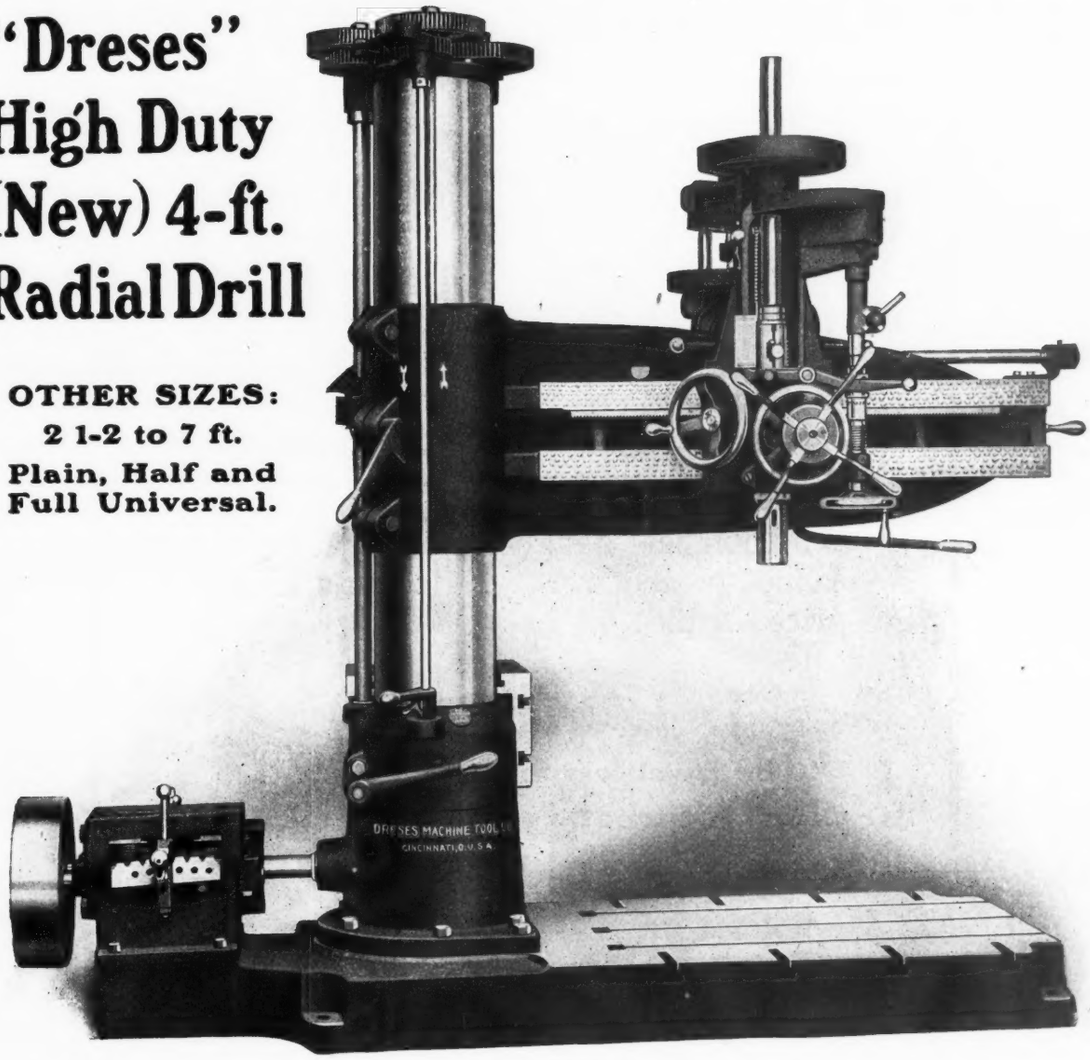
EASTERN BRANCH: Fulton Building, 50 Church Street, New York, Walter H. Foster & Co., Managers.

FOREIGN AGENTS: C. W. Burton, Griffiths & Co., London, E. C. F. G. Kretschmer & Co., Frankfort-on-Main, Germany. R. S. Stokvis & Zonen, Rotterdam, Holland. Fenwick Freres & Co., Paris, France. Schuchardt & Schutte, Yokohama, Japan.

A MECHANICAL GLUTTON!

"Dreses" High Duty (New) 4-ft. Radial Drill

OTHER SIZES:
2 1-2 to 7 ft.
Plain, Half and Full Universal.



THIS cost-reducing machine has been designed for the practical use of High Speed Drills, and is a model of **simplicity, convenience, rigidity** and **accuracy.** It will drive a 1¼" high speed drill to its best advantage, and possesses many other superior features.

All high speed Bearings are lined with removable Phosphor Bronze Bushings, all other bearings having interchangeable cast iron bushes of special metal. Feed is of Positive All-geared type and has four changes, each obtainable while drilling. Hand Feed works ahead of the power feed, affording a great saving in time.

Write for descriptive circular and learn the whole story.

Dreses Machine Tool Company

CINCINNATI, OHIO, U. S. A.

REPRESENTATIVES: Manning, Maxwell & Moore, Inc., New York, Boston, Philadelphia, Cleveland, Chicago, Detroit, Atlanta, Mexico City and Yokohoma; Carey Mchy. & Supply Co., Baltimore; Baird Mchy. Co., Pittsburg; Wm. C. Johnson & Sons Mchy. Co., St. Louis; Mine & Smelter Supply Co., Denver and Salt Lake City; Pacific Tool & Supply Co., San Francisco; Selson Engineering Co., London; C. Schinz, St. Petersburg; G. Koeppen & Co., Moscow; Wilh. Sonesson & Co., Malmo and Stockholm; Van Rietschoten & Houwens, Rotterdam; V. Lowener, Copenhagen and Christiania; Stuzzi & Zweifel, Milan; Alfred Herbert, Ltd., Paris, France, Belgium, Spain and Portugal; E. Sonnenthal, Jr., Berlin and Koln; White, Child & Beney, Vienna; Shewan Tomes & Co., Shanghai, Pekin and Canton; Castle Bros., Wolf & Sons, Manila.

All big Lathes are good Lathes—

but only **McCabe's "2-in-1" Lathe** is good for anything else when you have nothing big to do.

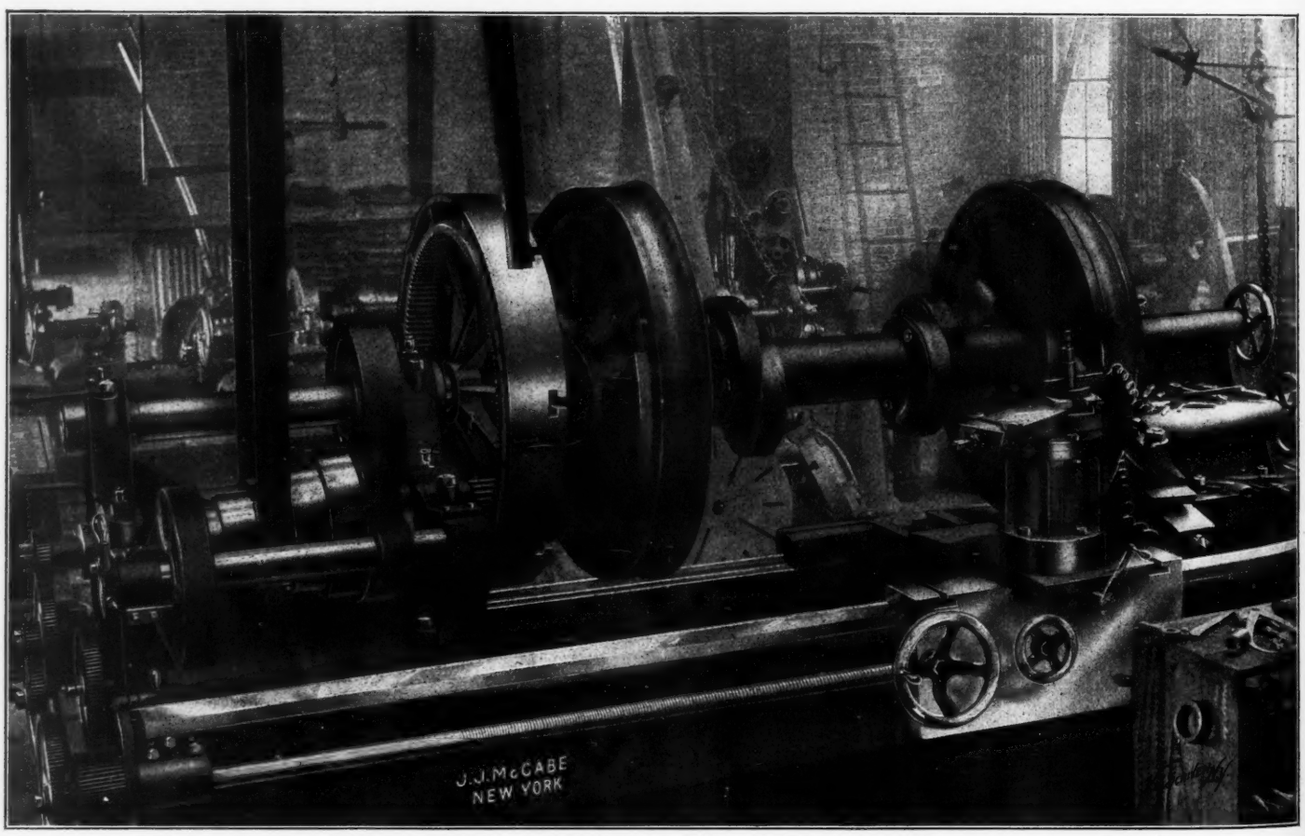
In the **McCabe Lathe,** the 26-inch Lathe displaces the 48-inch when you have no big work. Result: A Lathe running all the time, with a "slip on" lever you can change almost immediately from one to the other size.

Why purchase a higher-priced Lathe that cannot do the work of **McCabe's lower-priced** Lathe?

J. J. McCABE

"The Double-spindle Lathe Man"

30 Church Street, NEW YORK CITY



McCabe's New Style "2-in-1" Double-spindle Lathe—32-54 inch Swing—turning Locomotive Driving Wheels Weighing 7,000 lbs

The Expert Mechanic Wants the Best File. Give him one marked

NICHOLSON

U.S.A.

TRADE MARK

Made for workmen who need the best tools, there is nothing haphazard about the manufacture of Nicholson Files—the same stock, same process, same skill and same good temper result in the same sharp, clean-cutting files every time.

The skilled worker prefers a Nicholson File because it makes his work easier, insures a better finish and outwears a cheap file 3 to 1.

A copy of "File Filosophy", the guide book to File Economy, sent on request.

NICHOLSON FILE CO., Providence, R. I., U. S. A.

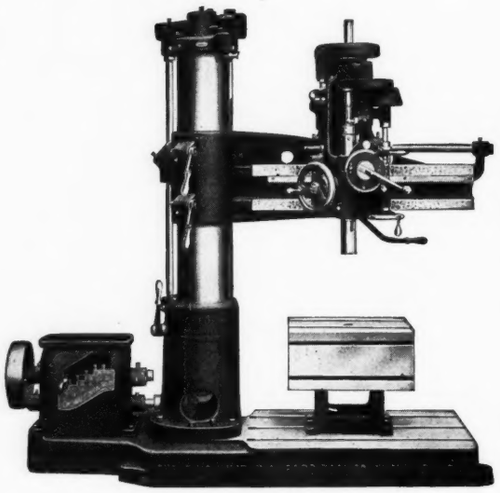
A Single Lever gives Six Speed Box Changes Instantly

The lever is merely *tossed* from one notch to another, while the NEW Bickford Radial Drill is running at high speed. And the gear box and back gears give TWELVE changes of speed.

They range from 38 to 356 revolutions per minute—correct for cutting at 35 feet, diameters of from $\frac{3}{8}$" to $3\frac{1}{2}$".

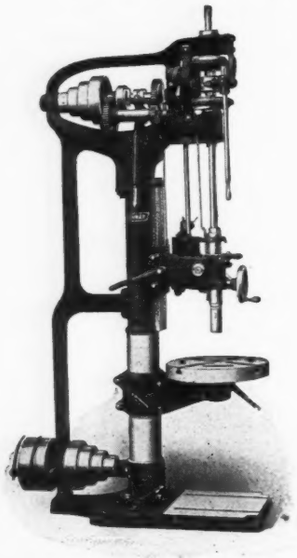
These are but a FEW features of the NEW Bickford Radial Drills.

We want to tell you MORE about them. Please write us today.



The New Bickford Radial Drill
$2\frac{1}{2}$, 3 and $3\frac{1}{2}$ feet.
Tables—Box, Swinging and Swivel.
Round auxiliary table made to fit either.

The Utmost Productive Capacity in Cincinnati Upright Drills



They are built for QUICK work—for SPEED combined with STABILITY. Made unusually STRONG and guaranteed in EVERY way.

And you'll find that the Cincinnati Drills far out-class others in weight, power and performance.

Learn the details from our Catalogue. Send for it NOW—while you think of it.

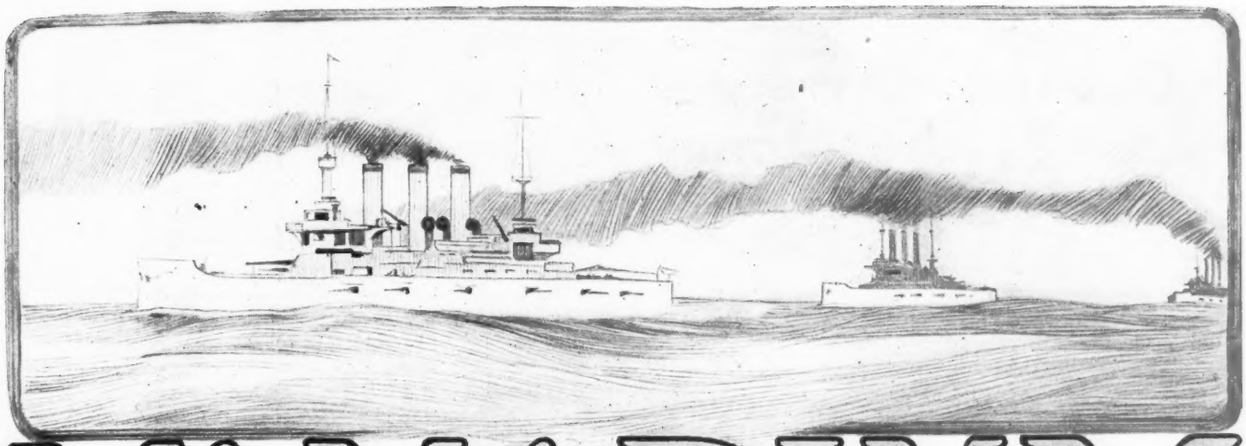
The Cincinnati Bickford Tool Co.

Cincinnati, Ohio, U. S. A.

THE CINCINNATI

21" Sliding Head Drill with Patent Geared Tapping Attachment.

DOMESTIC AGENTS—Prentiss Tool and Supply Co., New York, N. Y., Boston, Mass., Buffalo and Syracuse, N. Y.; W. E. Shipley Machinery Co., Philadelphia, Pa.; Brown & Zortman Machinery Co., Pittsburg, Pa.; Motch & Merryweather Machinery Co., Cincinnati and Cleveland, Ohio, and Detroit, Mich.; Marshall & Huschart Machinery Co., Chicago, Ill., Indianapolis, Ind., St. Louis, Mo.; Robinson, Cary & Sands Co., St. Paul and Duluth, Minn.; Hallidie Machinery Co., Seattle and Spokane, Wash.; Zimmerman-Wells-Brown Co., Portland, Ore.; Harron-Rickard & McCone, San Francisco, and Los Angeles, Cal.; Galligher Machinery Co., Salt Lake City, Utah; C. T. Patterson Co., Ltd., New Orleans, La.; Dewstoe & Lathrop Machinery Co., Birmingham, Ala.; Morrison Machinery & Supply Co., Richmond, Va. J. P. Kemp, Baltimore, Md.



VANADIUM

THE MASTER ALLOY

IF the armor of a battleship resists the shots fired at it, it is good; if it doesn't, it's junk.

If your tool steel cuts without breaking, and cuts well and long, it is good; if it doesn't, it's junk.

If your automobile axle gets a hard whack and stands it straight, it is good; if it doesn't, it's junk.

If the machinery you make or use serves the purpose for which it is made, it is good; if it doesn't, it's junk.

Are you buying junk?

Vanadium steel is safety steel. It is the steel that Nature pointed out when she put Vanadium in the Swedish ores; it is the steel that intelligence has perfected, and the steel that has the maximum of desirable qualities without complementary defects.

All tests and trials, from armor plate to engravers' tools, prove Vanadium steel the triumph of metallurgy.

Booklets, photographs, tests, free.

THE AMERICAN VANADIUM CO.
325 FRICK BUILDING PITTSBURGH, PA.

MACHINERY, N.Y.

Cutting Key-seats in the Latest Way? By the Money Saving Method?

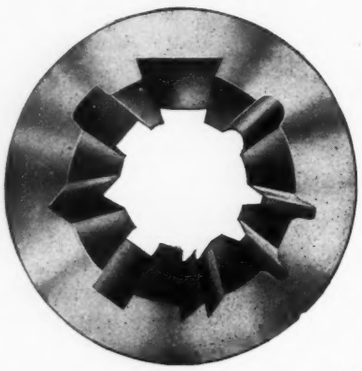


Figure 1

There are over 2500

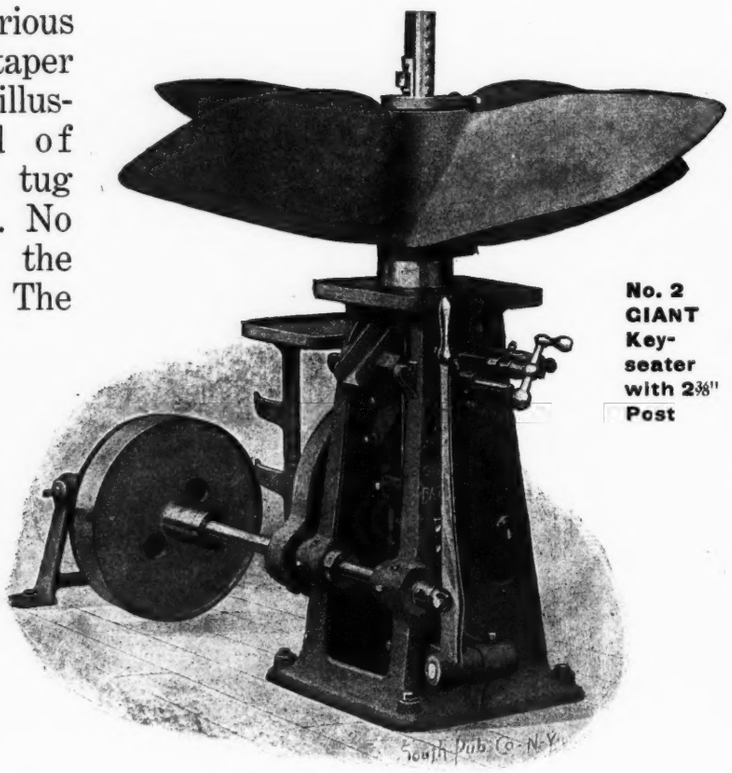
GIANT Key-Seating Machines

already in use

Because the ease with which either straight or taper work can be chucked is an exclusive feature, and has solved the problem of obtaining perfectly true, straight keyways without previous facing or finishing. Every piece is set by the bore alone. No spring or chatter is possible.

Figure 1 shows various keyways cut in a taper hole, and Figure 2 illustrates the method of chucking a heavy tug wheel or similar piece. No fastenings except the bushings are needed. The catalogue shows the full line.

How long does it take you to complete 6-inch key-seats? The **GIANT** cuts them in 2 minutes—including time to set the work and to take off the machine.



No. 2 GIANT Key-seater with 2⅜" Post

Figure 2

Give us a chance to prove it.

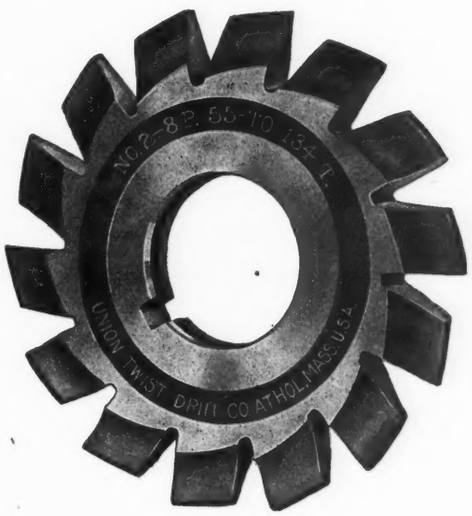
MITTS & MERRILL

843 Water Street, SAGINAW, MICH., U. S. A.

FOREIGN AGENTS: C. W. Burton, Griffiths & Co., London, England.
Heinrich Dreyer, Berlin, Germany, Austria and Russia.
J. E. Chabert & Co., Paris, France, Belgium and Switzerland.

SUPERIOR CUTTERS

Claims alone do not make a superior cutter but when those claims are backed up by a plant such as ours, having every known facility, and administered by an organization of men gathered on account of their expert knowledge of this particular line, then those claims have some meaning.



Our claim of **superiority** is justified by the actual results accomplished.

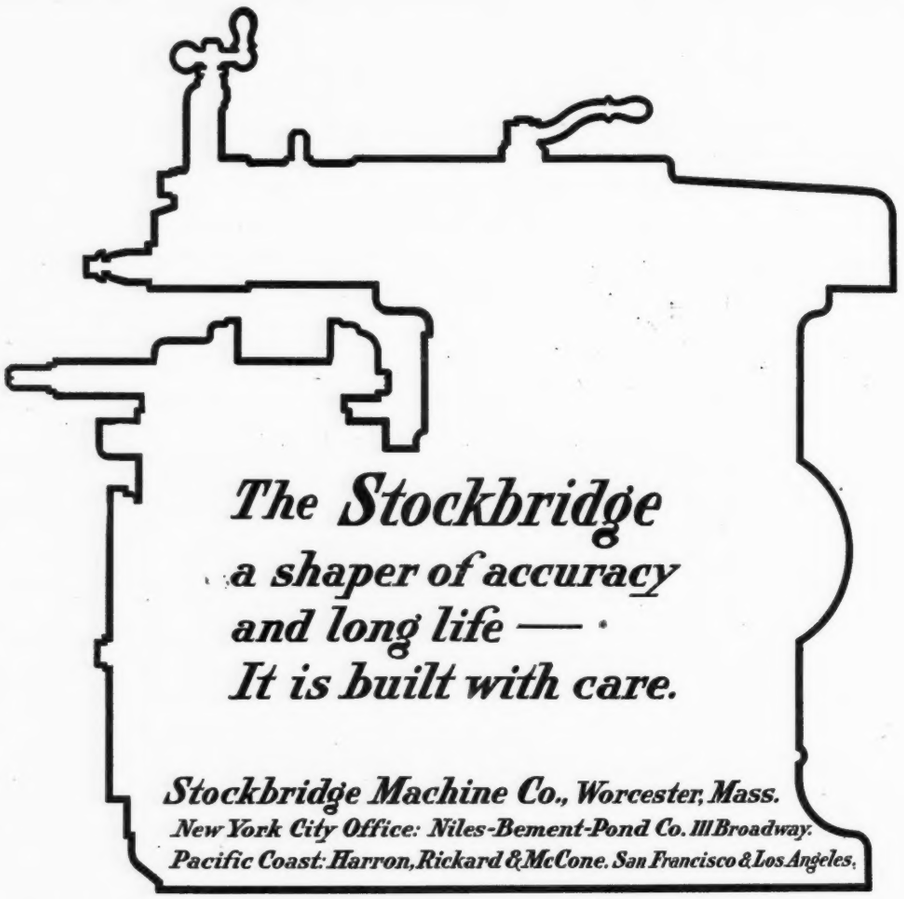
Superior cutters of quality, accuracy and high efficiency should be interesting to every user.

Are you interested? If so let us correspond.

UNION TWIST DRILL COMPANY

THE CUTTER MAKERS ATHOL, MASS., U. S. A.

FOREIGN AGENTS: Germany: Schmidt & Clemens, Frankfort, a/m. France: Alfred H. Schutte, 22-24 Rue de Petits Hotel, Paris. England: Chas. Neat & Co., 112 Queen Victoria St., London. Agents for Sweden: Wilh. Sonesson & Co., Malmo, Stockholm and Gothenburg. Agents for Denmark, Norway and Finland: Aktieselskabet Wilh. Sonesson & Co., Copenhagen City and Freeport. Australia: Thos. McPherson & Son, Melbourne. Japan: Takata & Co., Yokohama.



The Stockbridge
a shaper of accuracy
and long life —
It is built with care.

Stockbridge Machine Co., Worcester, Mass.
New York City Office: Niles-Bement-Pond Co. 111 Broadway.
Pacific Coast: Harron, Rickard & McCone. San Francisco & Los Angeles.

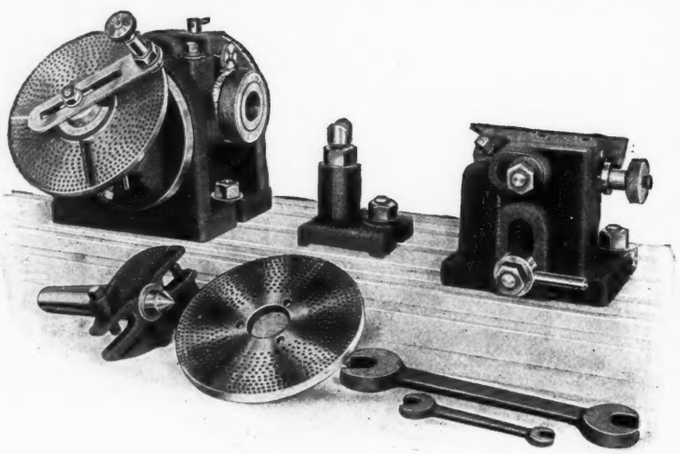
Leads from .120 to 100 inches

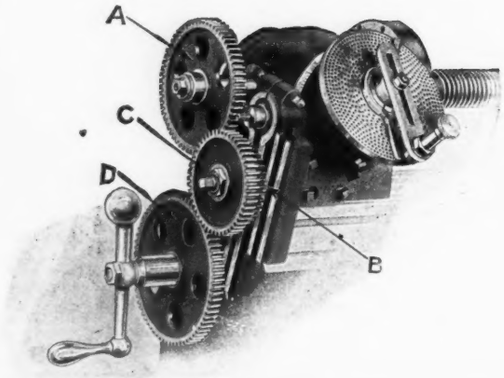
(574 different leads)

are obtainable on the

KEMPSMITH

New Type Universal Dividing Head





It is adapted to *thread milling*, worm cutting, etc., as well as the full range of usual spiral work possible on other dividing heads. This, and its many other remarkable new features, are elaborately described in the new book.

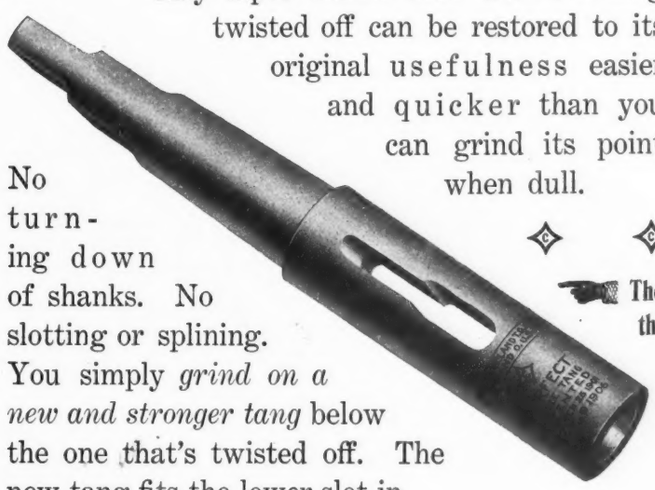
The Kempsmith Mfg. Co.
Milwaukee, Wis.

Agents for Great Britain, France, Germany, Belgium:
Selson Engineering Co., London, England.
Canadian Agents: Rudel-Yeates Machinery Co., Montreal.

Ready for the scrap heap.

From the Scrap Heap to the Drill Press

Any taper shank drill with its tang twisted off can be restored to its original usefulness easier and quicker than you can grind its point when dull.



No turning down of shanks. No slotting or splining. You simply *grind on a new and stronger tang* below the one that's twisted off. The new tang fits the lower slot in

The lower slot drives the second tang.

"PERFECT Double Tang" SOCKETS

(PATENTED)

Made as Rough, Fitted and Shell Sockets. They are simple, "fool-proof," and inexpensive; have no parts to get out of order, and will *fit any spindle* having a regular taper hole. With them you can

END YOUR TANG TROUBLES

RECLAIM YOUR SCRAP HEAP

Write for "D.T." Circular and discounts.

Ready for the drill-press.

The CLEVELAND Twist Drill Co.

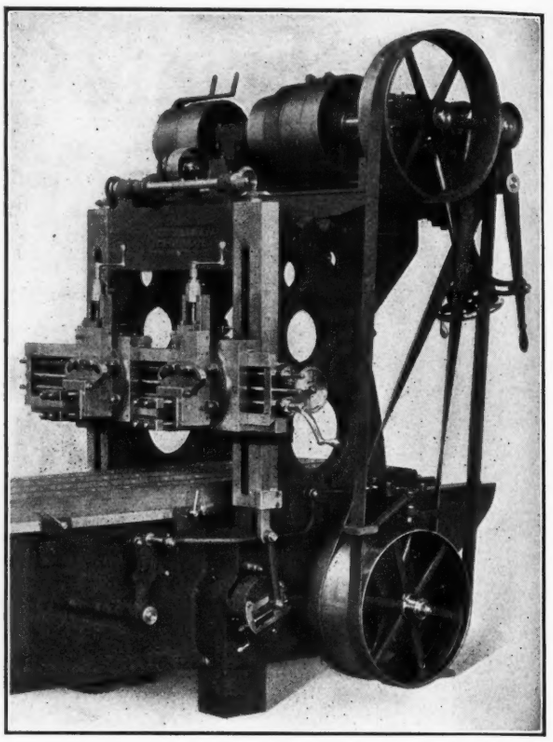
New York CLEVELAND, OHIO Chicago

ONE good tool will sell another, and one unsatisfactory tool will generally prevent the sale of another—at least to that particular customer and his neighbors. Many tools of one make in one locality indicate that they have "made good." That is why we are proud of the fact that

In Cleveland alone there are 198 Gray Planers;

In Chicago alone there are 229 Gray Planers;

In Cincinnati alone there are 258 Gray Planers.



Constant and variable-speed planers.

THE G. A. GRAY COMPANY, Cincinnati, O.

It is useless to try to do a Finished job of Gear Cutting with an Unfinished Cutter

In other words, if you expect to cut quiet-running gears, you must use a perfect cutter, one which first of all is based on a correct theory. Then it must be ground after it is hardened, and you have a finished cutter, i. e., one which will do a finished job of gear cutting. Such a cutter is the one used in the Gear Shaper system, and when operated in connection with the machine illustrated herewith, it will cut gears faster than any other type of cutter on the market.

The Fellows Gear Shaper Company

25 Pearl Street, SPRINGFIELD, VT., U. S. A.

FOREIGN AGENTS—Henry Kelley & Co., Manchester, Eng. Ph. Bonvillain & E. Ronceray, Paris, France. M. Koyemann, Dusseldorf, Germany. Adler & Eisenschitz, Milan, Italy. White, Child & Beney, Vienna, Austria. The C. & J. W. Gardner Co., St. Petersburg, Russia.

BARNES DRILLS

WITH THE

POSITIVE FEED that "makes them talk"

8 changes of feed on 26 to 50 inch Drills

4 changes of feed on 20 to 25 inch Drills

Our Feed is adapted to drilling, boring, reaming, etc.

UPRIGHT DRILLS - 8 to 50 inch Swing

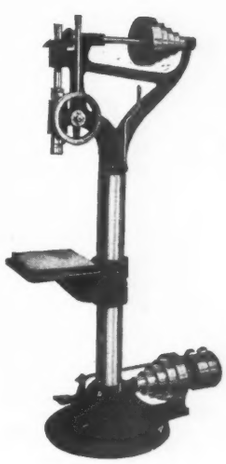
GANG DRILLS—HORIZONTAL DRILLS

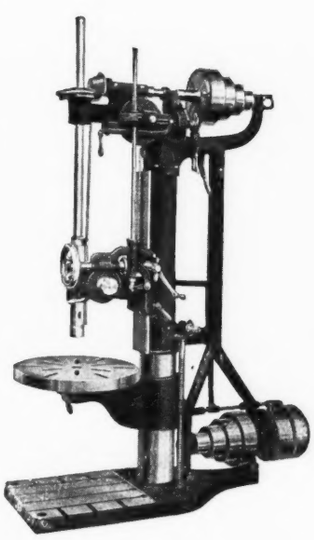
SEND FOR CATALOG

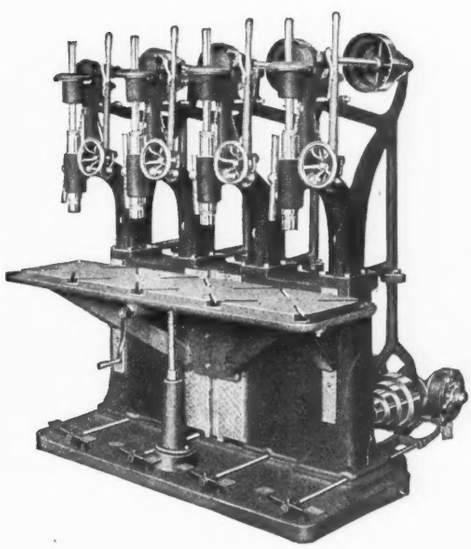
W. F. & John Barnes Company

231 RUBY STREET ROCKFORD, ILLINOIS

FOREIGN AGENTS—Fenwick Freres & Co., Paris. Chas. Churchill & Co., London. F. W. Horne, Yokohama



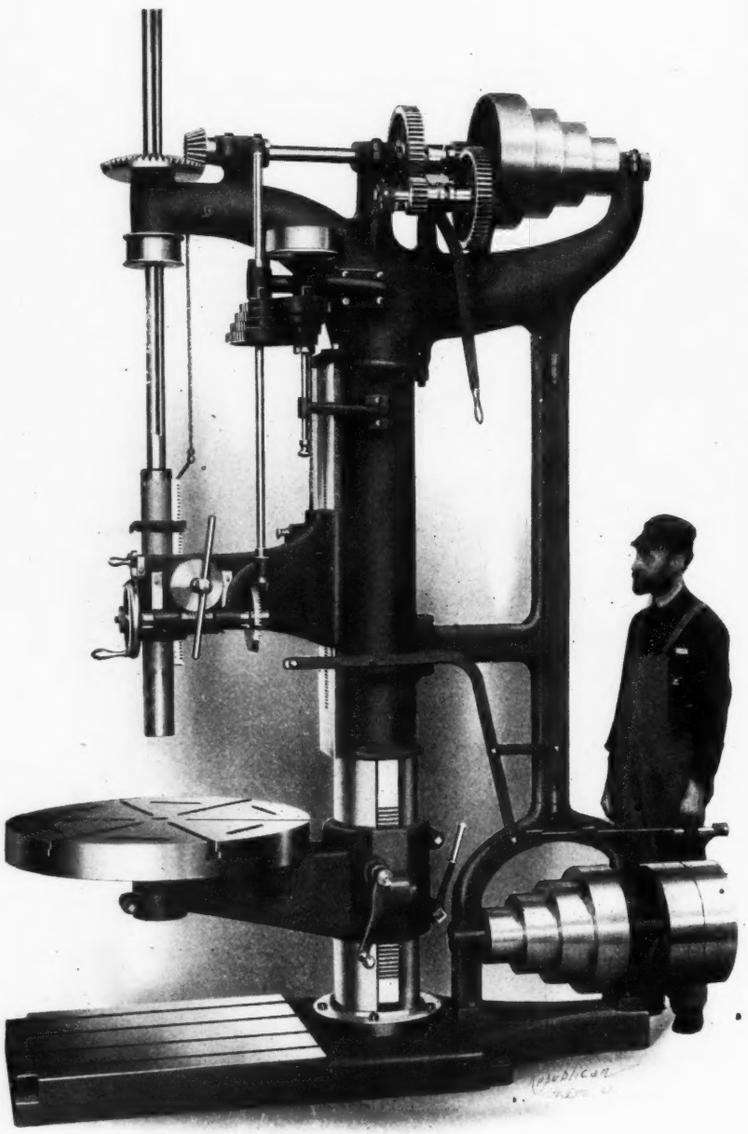




THE EARNING CAPACITY OF HAMILTON DRILLS

MAKES THE PURCHASE PRICE A SECONDARY MATTER.

No machines built as Hamilton Drills are built could be cheap, but their ability to reduce labor costs, improve product, maintain their initial accuracy and increase output, soon wipes out the first expense and puts them in the profit-bearing investment class.



The Regular Pattern Sliding Head Drills

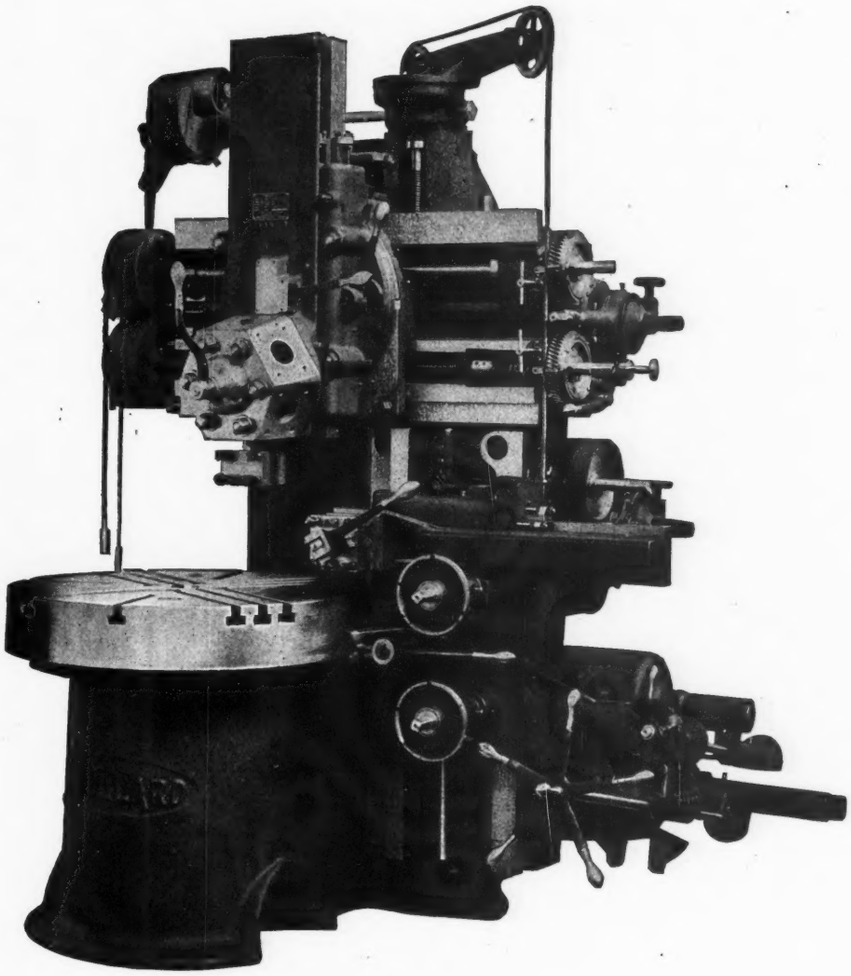
24-inch to 42-inch swing, are especially noted for correct proportion, insuring ample strength at every point, convenient arrangement of the various parts, accurate construction and symmetrical appearance. Counterbalanced sliding head, powerful back gears, quick return for spindle, power feed, automatic stop and adjustable table are regular Hamilton features, which contribute to the best results and insure long and efficient service.

Send for special circular with full description.

LATHES, SHAPERS, PLANERS, UPRIGHT AND RADIAL DRILLS.

The Hamilton Machine Tool Company

HAMILTON, OHIO, U. S. A.



It is easier to lay a piece of work down than to hang it up

And it's more productive too—machining face plate work on a Vertical Turret Lathe—than on the ordinary lathe with its horizontal construction and necessarily *small* spindle, just where strength and rigidity are most essential.

The Vertical Turret Lathe

with its vertical construction—rendering simple and easy the chucking and securing of work—permits a wide and massive angular table-spindle bearing with power applied close to the large diameter of the revolving work, allowing heavy cuts without vibration.

This feature is only one of the many—such as its ability to take two or more cuts at the same time—that make the Vertical Turret Lathe renowned for its productive capacity.

Our Catalog V-31 is full of concise reading matter for the manufacturer. Ask for a copy.

The Bullard Machine Tool Co.

BRIDGEPORT, CONN., U. S. A.

Alphabetical Index of Advertisers

Abrasive Material Co. 104
Acheson Oildag Co. 65
Acme Drill Co. 148
Acme Machinery Co. 45
Acme Mch. Tool Co. 89
Adams Co. 161
Adams-Bagnall Elec. Co. 52
Ajax Mfg. Co. 79
Almond, T. R. Mfg. Co. 177
American Emery Wheel Wks. 110
American Gas Furnace Co. 134
American Pulley Co. 124
American Specialty Co. 189
American Swiss File & Tool Co. 87
American Tool Works Co. 14
American Twist Drill Co. 124
American Vanadium Co. 27
Ams, Max, Machine Co. 166
Armstrong-Blum Mfg. Co. 181
Armstrong Bros. Tool Co. 121-150
Armstrong Mfg. Co. 190
Atkins, E. C., & Co., Inc. 172
Automatic Machine Co. 154

Baker Bros. 144
Baldwin Chain & Mfg. Co. 155
Bantam Anti-Friction Co. 164
Barnes, W. F. & J., Co. 33
Barnes Drill Co., Inc. 136
Barnett, G. & H., Co. ..... Back cover
Barr, H. G. 136
Bath Grinder Co. 108
Baush Mch. Tool Co. 8
Bay State Stamping Co. 182
Beaman & Smith Co. 15-173
Beaudry & Co. 185
Becker Milling Mch. Co. 78
Bemis & Call Co., H. & T., Inside front cover
Besly, Chas. H., & Co. 105
Betts Machine Co. 7
Bickford & Washburn 173
Bignall & Keeler Mfg. Co. 191
Bilgram Machine Works 158
Billings & Spencer Co. 70
Binsse Mch. Co. 11
Blanchard Machine Co. 52
Bliss, E. W., Co. 187
Boker, Hermann, & Co. 131
Boston Gear Works 159
Boulet's Fine Tool Works 181
Box, Alfred, & Co. 126
Bradford Mch. Tool Co. 9
Bradley, C. C., & Son 184
Bristol Co. ..... Back cover
Brown, H. B., Co. 189
Brown Hoisting Mchy. Co. 126
Brown & Sharpe Mfg. Co. 71
Brubaker, W. L., & Bros. 188
Bryant Chucking Grinder Co. 114
Buckeye Engine Co. 146
Buffalo Fdry. & Mch. Co. 185
Buffalo Specialty Co. 173
Bullard Mch. Tool Co. 35
Burke Mchy. Co. 50
Burnham, Royal E. 154
Burr, J. T., & Sons 189
Butler, A. G. 164
Butterfield & Co. 39

Calder, Geo. H. 113
Caldwell, H. W., & Son Co. 155
Cammell Laird & Co. 84
Carborundum Co. 111
Card, S. W., Mfg. Co. 115
Carpenter, J. M., Tap & Die Co. ..... 165-Back cover
Carpenter-Kerlin Gear & Mch. Co. 86
Carver File Co. ..... Back cover
Castellanos, A. W. 150
Celfor Tool Co. 148
Chambersburg Eng. Co. 185
Champion Tool Works Co. 21
Chicago Flexible Shaft Co. 132
Cincinnati Ball Crank Co. 184
Cincinnati Bickford Tool Co. 26
Cincinnati Chuck Co. 178
Cincinnati Gear Cutting Mch. Co. 20
Cincinnati Lathe & Tool Co. 122
Cincinnati Milling Mch. Co. 73
Cincinnati Planer Co. 19
Cincinnati Pulley Mchy. Co. 15
Cincinnati Punch & Shear Co. 184
Cincinnati Shaper Co. 20
Cleveland Auto Mch. Co. 62
Cleveland Planer Works 137
Cleveland Twist Drill Co., 31-70-Back cover
Cling-Surface Co. 46
Coates Clipper Mfg. Co. 90
Coes Wrench Co. 70-120
Columbia Steel Co. 164
Cook, Asa S., Co. 173
Cooper Hewitt Electric Co. 151
Crescent Machine Co. 188
Crocker-Wheeler Co. 143
Cullman Wheel Co. 158
Curtis & Curtis Co. 190
Curtis & Co. Mfg. Co. 156
Cushman Chuck Co. 176

Dallett, Thos. H., Co. 183
Davis, Rodney 158
Davis, W. P., Mch. Co. 53
Davis-Bournonville Co. 150
Davis Expansion Boring Tool Co. 89
Delphos Mfg. Co. 159
Desmond-Stephan Mfg. Co. 112
Detrick & Harvey Mch. Co. 145
Detroit Hoist & Mch. Co. 126
Diamond Chain & Mfg. Co. 125
Diamond Mch. Co. ..... Back cover
Diamond Saw & Stamping Wks. 40
Dienelt & Eisenhardt 185
Dill, T. C., Mch. Co. 122
Dixon, Jos., Crucible Co. 183
Dreses Mch. Tool Co. 23
Dudgeon, Richard 171

Earle Gear & Mch. Co. 158
Eck Dynamo & Motor Co. 140
Edgemont Mch. Co. 126
Electric Welding Products Co. 139
Elgin Tool Works 156
Erie Foundry Co. 185
Espen-Lucas Mch. Works 181
Evans, G. F. 184
Excelsior Needle Co. 187

Fay Machine Tool Co. 118
Fay & Scott 159
Fellows Gear Shaper Co. 32
Ferracute Machine Co. 166
Firth-Sterling Steel Co. 58
Fitchburg Mch. Works 89
Flather & Co. 135
Flather, E. J., Mfg. Co. 50
Flather, Mark, Planer Co. 144
Foos Gas Engine Co. 150
Foote Bros. Gear & Mch. Co. 160
Ford Chain Block Co. 124
Foreign Machinery Merchants 12
Fort Wayne Electric Works 142
Fosdick Mch. Tool Co. 118
Foster Machine Co. 82
Fox Machine Co. 67
Franklin Mfg. Co. 188
Fritz Mfg. Co. 189

Gandy Belting Co. 180
Gang, Wm. E., Co. 144
Ganschow, Wm., Co. 158
Gardner Mch. Co. 110
Garvin Mch. Co. 52
General Electric Co. 141
Geometric Tool Co. 113
Gerstner, H., & Sons 180
Gisholt Machine Co. 97
Gleason Works, Front cover-Back cover
Globe Mch. & Stamping Co. 51
Goldschmidt Thermit Co. 47
Gorton, George, Mch. Co. 173
Gould & Eberhardt 161
Graham Mfg. Co. 192
Grant Gear Works 158
Grant Mfg. & Mch. Co. 70
Gray, G. A., Co. 32
Greaves, Klusman & Co. 156
Greene, Tweed & Co. 96
Greenfield Mch. Co. 102

Hamilton Mch. Tool Co. 34
Hammacher, Schlemmer & Co. 77
Hardinge Bros. 192
Harrington, Edwin, Son & Co. 127
Hart Mfg. Co. 49
Hawkridge Bros. Co. 165
Hay-Budden Mfg. Co. 49
Hayes File Co. 150
Heald Machine Co. 163
Heller Bros. Co. 52
Hendey Mch. Co. 13
Henley, Norman W., & Son 41
Henry & Wright Mfg. Co. 87
Hill, Clarke & Co. 80-81
Hisey-Wolf Mch. Co. 143
Hoefer Mfg. Co. 137
Hoffman, Geo. W. 188
Hoggson & Pettis Co. 175
Horsburgh & Scott Co. 160
Horton, E., & Son Co. 175
Horton, S. E., Mch. Co. 174
Howson & Howson 174
Hoysradt & Case 52
Hurlbut-Rogers Mch. Co. 194
Huther Bros. Saw Mfg. Co. 188

Industrial Press, The 167-170
Ingersoll Milling Mch. Co. 22
Ingersoll-Rand Co. 125
International Cor. Schools 91
International Mch. Tool Co. 65

Jacobs Mfg. Co. 179
Jessop, Wm., & Sons, Ltd. 49
Johnson, Carlyle, Mch. Co. 83
Jones & Lamson Mch. Co. 16-17

Kearney & Trecker Co. 10
Kelly, R. A., Co. 144
Kelly Reamer Co. 126
Kempsmith Mfg. Co. 30
Kern Machine Tool Co. 67
Keuffel & Esser Co. 151
King Machine Tool Co. 113
Kinkead Mfg. Co. 54
Knecht Planer Co. 70
Knight, W. B., Mchy. Co. 156
Kolesch & Co. 159

Landis Machine Co., Inc. 44
Landis Tool Co. 109
Lapointe Mch. Tool Co. 128
Lea Equipment Co. 172
LeBlond Mch. Tool Co. 37-42-43
LeCount, Wm. G. 184
Lees-Bradner Co. 157
Leiman Bros. 146
Lincoln-Williams Twist Drill Co. 84
Lodge & Shipley Mch. Tool Co. 6
Loew Mfg. Co. 189
Long & Allstatter Co. 186
Lovejoy Co. 180
Lucas Mch. Tool Co. 75
Lufkin Rule Co. 51
Lumen Bearing Co. 164
Lutter & Gies 112

Macdonald & Macdonald 154
Machinery Forging Co. 113
Manning, Maxwell & Moore, Inc. 102
Marbach, F. G., Co. 113
Maris Bros. 126
Mason, Volney W., & Co. 156
Massillon Fdry. & Mch. Co. 186
McCabe, J. J. 24-152
McCabe Mch. Co. 152
McCrosky Reamer Co. 151
McCullough-Dalzell Crucible Co. 194
Mechanics Mch. Co. 136
Merrell Mfg. Co. 190
Merrill Bros. 181
Miami Valley Mch. Tool Co. 112
Milled Screw & Mch. Co. 147
Millers Falls Co. ..... Back cover
Milwaukee Fdry. Sup. Co. 113
Milwaukee Mch. Tool Co. 89
Miner & Peck Mfg. Co. ..... Back cover
Mitts & Merrill 28
Modern Tool Co. 174
Moline Tool Co. 136
Morris, J. B., Mch. Tool Co. 180
Morrow Mfg. Co. 174
Morse Chain Co. 122
Morse Twist Drill & Mch. Co. 100
Morse, Williams & Co. 162
Morton Mfg. Co. ..... Inside front cover
Motch & Merryweather Mchy. Co. 152
Mueller Mch. Tool Co. 86
Mummert, Wolf & Dixon Co. 188

National Acme Mfg. Co. 193
National Machinery Co. 63
National Mch. & Tool Wks. 67
National Tool Co. 146
National Tube Co. 164
National Twist D. & T. Co. 64
Nazel Eng. & Mch. Wks. 39
Newark Gear Cutting Mch. Co. 157
New Britain Mch. Co. 173
New England Gear Works 155
New Haven Mfg. Co. 135
New Process Raw Hide Co. 162-163
New Process Twist Drill Co. 148
Newton Mch. Tool Works, Inc. 61
New York Belting & Packing Co. 94
Nicholson, W. H., & Co. 171
Nicholson File Co. 25
Niles-Bement-Pond Co. 68-69-153
Noble & Westbrook 164
Northern Engineering Wks. 127
Norton Co. 107
Norton Grinding Co. 106
Nuttall, R. D., Co. 160

Obermayer, S., Co. 150
Oesterlein Mch. Co. 18
Ohio Mch. Tool Co. 88
Oil & Waste Saving Mch. Co. 152
O. K. Tool Holder Co. 189
Olney & Warrin 175
Oneida National Chuck Co. 175
Osgood, J. L. 172
Otto Gas Engine Works 183
Owen Mch. Tool Co. 85
Owen, R. B. 154

Parker, C. L. 154
Parker White Metal & Mch. Co. 126
Pawling & Harnischfeger Co. 145
Peerless Rubber Mfg. Co. 94
Philadelphia Gear Wks., Inc. 159
Philips Pressed Steel Pulley Works 129
Phosphor Bronze Smelting Co. 40
Pillliod Lumber Co. 138
Poole Eng'r'g & Mch. Co. 182
Potter & Johnston Mch. Co. 60
Pratt Chuck Co. 176
Pratt Institute 150
Pratt & Whitney Co. 4-5
Prentice Bros. Co. ..... Inside back cover
Prentice, Geo. G., & Co. 52
Prentiss Tool & Supply Co. 56
Prentiss Vise Co. 180
Prescott, Sydney I. 154
Pressed Steel Mfg. Co. 148

Quint, A. E. 48
Quride Co. 158

Racine Tool & Mch. Co. 172
Rahn-Carpenter Co. 156
Ransom Mfg. Co. 111
Ready Tool Co. 150
Recording Register & Fare Box Co. 189
Reece, E. F., Co. 165
Reed, F. E., Co. 59
Reed, Francis, Co. 155
Reed Mfg. Co. 180
Reeves, Paul S., & Son 49
Reeves Pulley Co. 149
Reichheim, E. P., & Co. 87
Reliance Elect. & Eng. Co. 140
Remington Tool & Mch. Co. 166
Reynolds Mchy. Co. 128
Rhoads, J. E., & Sons 45
Rhodes, L. E. 86
Richards, I. P., Co. 184
Rivett Lathe Mfg. Co. 194
Robbins Mch. Co. 88
Robinson Tool Works 113
Rockford Drilling Mch. Co. 117
Rockford Lathe & Drill Co. 88
Rockford Mch. Tool Co. 119
Rockford Tool Co. 154
Rockwell Furnace Co. 133
Rockwell, W. S., Co. 180
Rogers, J. M., Works, Inc. 174
Root, C. J., Co. 152
Roth Bros. & Co. 155
Royersford Foundry & Mch. Co., 161-164
Ryerson & Son, Jos. T. 54A-54B

Safety Emery Wheel Co. 110
Saginaw Mfg. Co. 181
Sames, Chas. M. 188
Saunders, D., Sons 190
Sawyer Tool Mfg. Co. 165
Schellenbach-Hunt Tool Co. 147
Schneider & Goosmann Mch. Co. 155
Schuchardt & Schutte 157
Schumacher & Boye 18
Schwerdtle Stamp Co. 175
Scranton & Co. 184
Second Hand Machinery 172
Sellers, Wm., & Co., Inc. 98
Seneca Falls Mfg. Co. 147-154
Shepard Electric Crane & Hoist Co. 127
Shore Instrument & Mfg. Co. 154
Sibley Mch. Tool Co. 119
Simonds Mfg. Co. 39
Skinner Chuck Co. 178
Slate, Dwight, Mch. Co. 116
Slocomb, J. T., Co. 151
Smart, A. J., Mfg. Co. ..... Back cover
Smith, E. G. 173
Smith & Mills Co. 150
Snyder, J. E., & Son 3
Spacke, F. W., Mch. Co. 156
Sprague Electric Co. 44
Springfield Machine Tool Co. 57
Standard Engineering Co. 191
Standard Gauge Steel Co. 97
Standard Mchy. Co. 176
Standard Tool Co. 55
Standard Welding Co. 130
Stark Tool Co. 188
Starrett, L. S., Co. 93
Steiner, E. E. 184
Steinle Turret Mch. Co. 82
Steptoe, John, Shaper Co. 150
Sterling Emery Wheel Mfg. Co. 112
Stevens, Milo B., & Co. 154
Stewart Heater Co. 182
Stockbridge Machine Co. 30
Stoever Fdry. & Mfg. Co. 188
Story, H. T. 181
Stow Flexible Shaft Co. 166
Stow Mfg. Co. 181
Sturtevant, B. F., Co. 38
Superior Mch. Tool Co. 116
Swaine, Fred J., Mfg. Co. 187
Syracuse Twist Drill Co. 182

Tabor Mfg. Co. 101
Taylor & Fenn Co. 84
Taylor-Wilson Mfg. Co., Inside front cover
Technical Press 152
Terrell's Equipment Co. 138
Thompson Grinder Co. 81
Thomson Electric Welding Co. 182
Toledo Electric Welder Co. 95
Toledo-Massillon Bridge Co. 127
Toledo Mch. & Tool Co. 188
Toomey, Frank, Inc. 152
Trimont Mfg. Co. 191
Trump Bros. Mch. Co. 173
Tucker, W. M. & C. F. 40

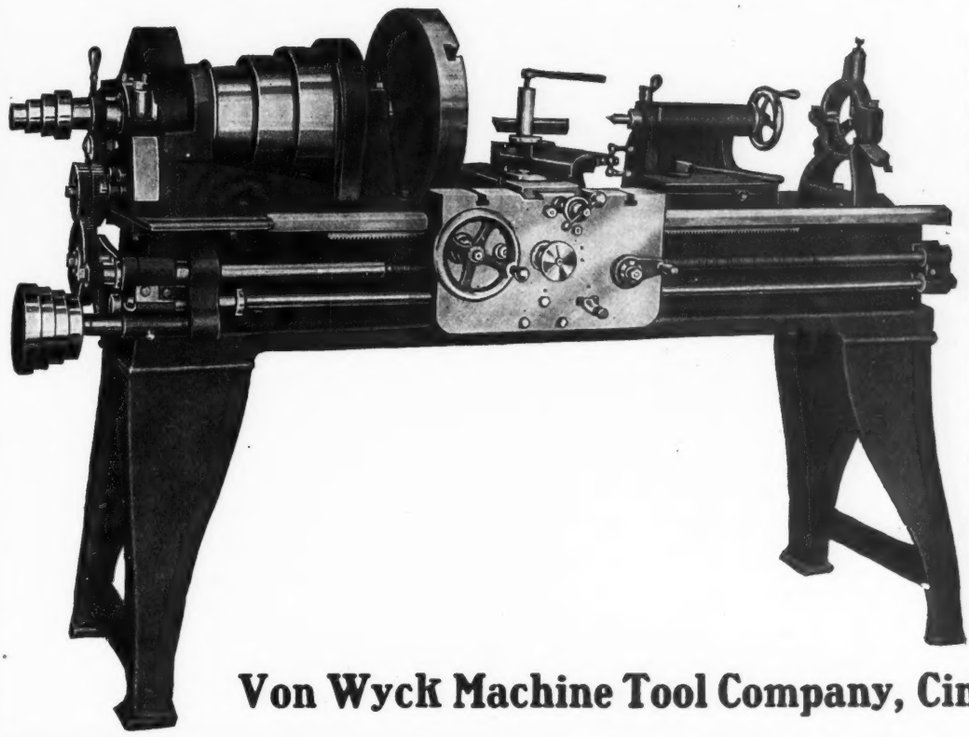
Underwood, H. B., & Co. 145
Union Mfg. Co. 175
Union Twist Drill Co. 29
U. S. Electrical Tool Co. 66
Universal Boring Mch. Co. 80
Universal Mch. Screw Co. 96

Valley City Mch. Wks. 112
Vandyck Churchill Co. 186
Van Dorn & Dutton Co. 143-160
Van Dorn Iron Works Co. 138
Veeder Mfg. Co. 189
Vitrified Wheel Co. 108
Von Wyck Mch. Tool Co. 37

Wagner Electric Mfg. Co. 142
Walcott & Wood Mch. Tool Co. 98
Walker, O. S., & Co. ..... Back cover
Waltham Mch. Works 159
Waltham Watch Tool Co. 96
Walton Co. 46
Walworth Mfg. Co. 3
Ward, Edgar T., & Sons 164
Warner Instrument Co. 140
Warner & Swasey Co. 83
Washburn Shops 150
Waterbury Farrel F. & M. Co. 70
Watson-Stillman Co. 128
Wedell & Boers 138
Wells, F. E., & Son Co. 104
Wells Bros. Co. 92
Westcott Chuck Co. 175
Western Tool & Mfg. Co. 172
West Haven Mfg. Co. 47
Westinghouse Elec. & Mfg. Co. 142
Whitcomb-Blaisdell Mch. Tool Co. 99
Whitman & Barnes Mfg. Co. 149
Whitney Mfg. Co. 123
Whiton, D. E., Mch. Co. 134
Whittlesey, Geo. P. 154
Wiley & Russell Mfg. Co. 92
Williams, J. H., & Co. 86
Williams Fdry. & Mch. Co. 144
Williams, White & Co. 186
Wilmarth & Morman Co. 112
Wilson, W. A., Machine Co. 70
Windsor Mch. Co. 85
Wood's, T. B., Sons Co. 51
Woodward & Powell Planer Co. 3
Wyke, J., & Co. 164
Wyman & Gordon Co. 182

Yale & Towne Mfg. Co. 129

Von Wyck 15" Engine Lathe— For General and Special Work



This high grade machine embraces all improved forms of practical design and construction.

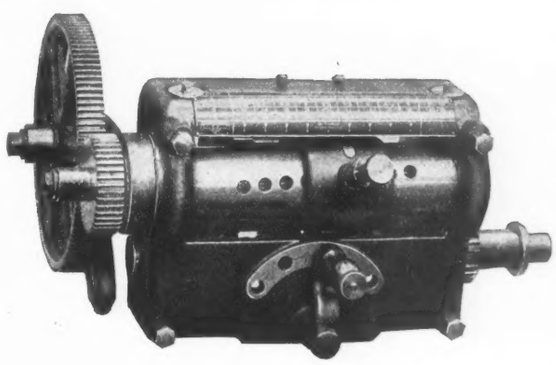
Three-step cone, double back gears, instantaneous change gear device if desired.

For strength, efficiency, convenience and economy the Von Wyck is not equalled by any lathe of its swing.

•Write for price and specifications

Von Wyck Machine Tool Company, Cincinnati, O.

THE QUICK CHANGE GEAR



applied to our HEAVY DUTY Lathes is made complete in one unit.

Thirty-six changes for threads from 2 to 30, including 11½ pipe are obtained with but two operating levers.

These levers are conveniently located on the front of the lathe with a direct reading index plate immediately above, enabling the operator to determine at a glance the proper setting for any thread or feed.

The mechanism consists of a tumbler operating on a cone of nine gears giving nine changes of speed which are quadrupled by a sliding gear transmission immediately below the cone.

The tumbler plate cannot bind on the large cylindrical bearing and is securely locked in position by a plunger operating through the center of the handle.

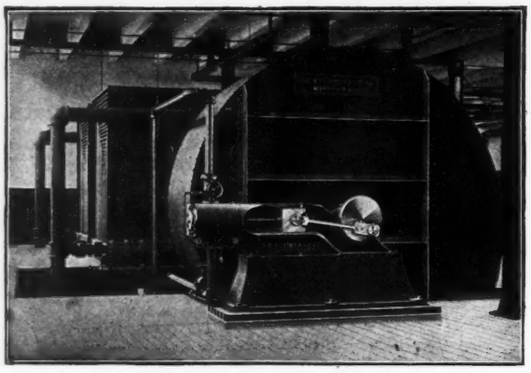
The unit construction of this mechanism leaves the end of the Lathe open, permitting the insertion of change gears for chasing special threads when required.

Insist on these money-saving features when buying Lathes.

The R. K. LeBlond Machine Tool Company

CINCINNATI, OHIO

NOW IS THE TIME



TO ARRANGE FOR

NEXT WINTER'S Heating Apparatus

NO scattered steam piping, and the Sturtevant Fan will force the warm air to go where it is wanted.

"The Fan Blower Specialists"

Send for Catalog No. 84

B. F. Sturtevant Co.

General Office and Works, Hyde Park, Mass.

Designers and Builders of Heating, Ventilating, Drying and Mechanical Draft Apparatus; Fan Blowers and Exhausters, Rotary Blowers and Exhausters; Steam Engines, Electric Motors and Generating Sets; Pneumatic Separators, Fuel Economizers, Forges, Exhaust Heads, Steam Traps, Steam Turbines, etc

112-M

CLASSIFIED INDEX TO ADVERTISEMENTS

Abrasive Materials
Abrasive Material Co.....104
American Emery Wheel Wks.110
Carborundum Co. 111
Norton Co. 107
Safety Emery Wheel Co. 110
Vitrified Wheel Co. 108

Accumulators, Hydraulic
Niles-Bement-Pond Co...68-69-153
Waterbury Farrel Fdry & Mch. Co. 70
Watson-Stillman Co. 128

Air Lifts
Ingersoll-Rand Co. 125

Alloys
American Vanadium Co..... 27

Alundum
See Grinding Wheels.

Anti-Friction Metal
Reeves & Son, P. S..... 49

Arbor Presses
Fox Mch. Co. 67
Lucas Mch. Tool Co..... 75
Niles-Bement-Pond Co...68-69-153
Seneca Falls Mfg. Co....147-154

Arbors
Cleveland Twist Drill Co. 31-70-Back cover
Morse Twist Drill & Mch. Co...100
Pratt Chuck Co.....176
Skinner Chuck Co.....178
Union Mfg. Co. 175
Union Twist Drill Co. 29
Wilmarth & Morman Co.....112

Balancing Tools
Rockford Tool Co.....154

Balls, Steel
Boker & Co., Hermann.....131

Bars, Boring
Beaman & Smith Co.....15-173
Cleveland Twist Drill Co., 31-70-Back cover
Davis Expansion Boring Tool Co. 89
Niles-Bement-Pond Co...68-69-153
Ryerson & Son, Jos. T...54A-54B
Underwood & Co, H. B.....145

Bearings, Ball and Roller
Bantam Anti-Friction Co.....164
Boston Gear Works.....159
Royersford Fdy. & Mch. Co. 101-164

Belt Bench
Tabor Mfg. Co.....101

Belt Clamps
Hoggson & Pettis Mfg. Co....175

Belt Fasteners
Bristol Co.....Back cover
Greene, Tweed & Co..... 96

Belt Filler
Cling-Surface Co..... 46

Belt Lacing, Metal
Bristol Co.....Back cover

Belting, Cotton
Gandy Belting Co.....180

Belting, Leather
Rhoads & Sons, J. E..... 45

Belting, Rubber
New York Belting & Packing Co..... 94

Bending Machinery, Hydraulic
Niles-Bement-Pond Co...68-69-153
Sellers & Co., Inc., Wm..... 98

Bending Machines, Pipe
Stoever Fdry. & Mfg. Co....188

Bending Machines, Plate
Long & Allstatter Co.....186
Niles-Bement-Pond Co..69-69-153
Sellers & Co., Inc., Wm..... 98
Whitcomb-Blaisdell Mch. Tool Co..... 99

Bending Machines, Power
National Mchy. Co..... 63
Niles-Bement-Pond Co...68-69-153
Sellers & Co., Inc., Wm..... 98

Bending Tools
Niles-Bement-Pond Co...68-69-153
Underwood & Co., H. B.....145

Blanks, Nuts and Screw
Electric Welding Products Co.139

Blocks, Chain
See Hoists, Hand.

Blocks, Die
Nicholson & Co., W. H.....171

Blowers
American Gas Furnace Co....134
Chicago Flexible Shaft Co...132
General Electric Co.....141
Hoysradt & Case..... 52
Leiman Bros.....146
Niles-Bement-Pond Co...68-69-153
Roth Bros. & Co.....155
Sturtevant Co., B. F. 38
Westinghouse Elec. & Mfg Co..142

Blue Print Machines
Buckeye Engine Co.....146
Keuffel & Esser Co.....151

Blue Print Paper
Keuffel & Esser Co.....151

Boiler Tubes
National Tube Co.....164

Bolt and Nut Machinery
Acme Mchy. Co..... 45
Ajax Mfg. Co..... 79
Brown Co., H. B. 189
Davis Machine Co., W. P. 53
Detrick & Harvey Mch Co.....145
Harrington, Son & Co., Edwin.127
Landis Machine Co., Inc. 44
Mummert, Wolf & Dixon Co...188
National-Acme Mfg. Co.....193
National Machinery Co..... 63
New Haven Mfg. Co.....135
Newton Mch. Tool Wks., Inc.. 61
Niles-Bement-Pond Co..68-69-153
Prentiss Tool & Supply Co.... 56
Sellers & Co., Inc., Wm. 98
Standard Engineering Co.....191
Waterbury Farrel Fdry. & Mch. Co..... 70
Wells Bros. Co. 92
Wiley & Russell Mfg. Co..... 92

Bolt Pointing Machines
Acme Mchy. Co..... 45
Brown Co., H. B.....189
Landis Mch. Co., Inc..... 44
National Mchy. Co..... 63

Bolts and Nuts
Electric Welding Products Co.139
National-Acme, Mfg. Co.....193

Books, Technical
MACHINERY'S Reference Series, 167-170
Henley & Son, Norman W.... 41
Sames, C. M. 188
Technical Press 152

Boosters
Roth Bros. & Co.....155
Westinghouse Elec. & Mfg. Co.142

Boring and Drilling Machines, Horizontal
Barnes Co., W. F. & John.... 33
Beaman & Smith Co.....15-173
Betts Mch. Co. 7
Binsse Mch. Co. 11
Detrick & Harvey Mch. Co....145
Fitchburg Machine Works.... 89
Fosdick Mch. Tool Co.....118
Gisholt Mch. Co. 97
Hill, Clark & Co., Inc.....80-81
Hoefer Mfg. Co. 137
Lucas Machine Tool Co..... 75
Manning, Maxwell & Moore, Inc. 102
McCabe, J. J.....24-152
Motch & Merryweather Machinery Co. 152
New Haven Mfg. Co.....135
Newton Mch. Tool Wks., Inc.. 61
Niles-Bement-Pond Co..68-69-153
Pawling & Harnischfeger Co..145
Prentiss Tool & Supply Co... 56
Rockford Drilling Mch. Co....117
Sellers & Co., Inc., Wm..... 98
Universal Boring Mch. Co. .. 80
Vandyck Churchill Co.....186
Whitcomb-Blaisdell Mch. Tool Co. 99

Boring Tools
Armstrong Bros. Tool Co.121-150
Cleveland Twist Drill Co., 31-70-Back cover
Davis Expansion Boring Tool Co. 89
Pratt & Whitney Co. 4-5
Western Tool & Mfg. Co. 172

Boring Tools, Car Wheel
Davis Expansion Boring Tool Co. 89

Boring Tools, Expansion
Davis Expansion Boring Tool Co. 89

Boring and Turning Mills, Vertical
American Tool Wks. Co..... 14
Baker Bros. 144
Betts Mch Co. 7
Bullard Mch. Tool Co. 35
Flather Mfg. Co., E. J..... 50
Gisholt Mch. Co. 97
Harrington, Son & Co., Edwin.127
Mitts & Merrill 28
Newton Mch. Tool Wks., Inc.. 61
Niles-Bement-Pond Co...68-69-153
Sellers & Co., Inc., Wm..... 98
Springfield Mch. Tool Co. 57

Broaching Machines
Harrington, Son & Co., Edwin.127
Hill, Clarke & Co., Inc.....80-81
Lapointe Mch. Tool Co.....128

Broken Tap Remover
Walton Co. 46

Bronze Bearings
Lumen Bearing Co. 164
Reeves & Son, P. S..... 49

Bronze Castings, Bushings, etc.
Reeves & Son, P. S. 49

Bulldozers
Ajax Mfg. Co..... 79
Bliss Co., E. W. 187
National Mchy. Co. 63
Niles-Bement-Pond Co. .68-69-153
Williams, White & Co. 186

Burners, Oil or Gas
Rockwell Furnace Co. 133

Bushings
National Tube Co. 164
Walworth Mfg. Co 3

Cabinets, Blue Print
Fritz Mfg. Co. 189

Cabinets, Tool
Armstrong Bros. Tool Co.121-150
Hammacher, Schlemmer & Co.. 77
Morse Twist Drill & Mch. Co..100

Calipers
Brown & Sharpe Mfg. Co.... 71
Slocomb Co., J. T. 151
Starrett Co., L. S. 93

Cams
Bilgram Machine Works.....158
Boston Gear Works.....159

Carbonizing
American Gas Furnace Co....134

Carborundum
See Grinding Wheels.

Case-Hardening
American Gas Furnace Co....134
Chicago Flexible Shaft Co. ..132
Rockwell Furnace Co.....133
Williams & Co., J. H. 86

Castings
Brown & Sharpe Mfg. Co..... 71
Lumen Bearing Co.....164
Phosphor Bronze Smelting Co. 40
Union Mfg. Co. 175

Castings, Die Molded
Franklin Mfg. Co.....188
Parker White Metal & Mch. Co.126
Veeder Mfg. Co.....189

Castings, Vanadium
American Vanadium Co..... 27

Cement, Iron
Obermayer Co., S. 150

Center Grinders
Heald Mch. Co. 103
Hisey-Wolf Mch. Co. 143
Mueller Mch. Tool Co. 86
Trump Bros. Mch. Co.....173

Centering Machines
Hendey Mch. Co. 13
Niles-Bement-Pond Co...68-69-153
Pratt & Whitney Co. 4-5
Springfield Mch. Tool Co..... 57
Wells & Son Co., F. E.....104
Whiton Mch Co., D. E.....134

Centers, Milling
Bickford & Washburn, Inc. ...173

Centers, Planer
Cincinnati Planer Co..... 19
Fay & Scott 159
Morse Twist Drill & Mch. Co..100
New Haven Mfg. Co.....135
Niles-Bement-Pond Co...68-69-153
Reed Co., F. E. 59
Woodward & Powell Planer Co. 3

Chain Blocks
Ford Chain Block Co. 124

Chain Blocks, Differential, Duplex and Triplex
Yale & Towne Mfg. Co.....129

Chains
Baldwin Chain & Mfg. Co....155
Diamond Chain & Mfg. Co....125
Whitney Mfg. Co. 125

Chains, Driving
Boston Gear Works.... 159
Diamond Chain & Mfg. Co. ..125
Morse Chain Co. 122
Whitney Mfg. Co. 125

Chucking Machines
Acme Machine Tool Co..... 89
American Tool Wks. Co..... 14
Brown & Sharpe Mfg. Co... 71
Cleveland Automatic Machine Co. 62
Davis Mch. Co., W. P..... 53
Garvin Machine Co. 52
Gisholt Mch. Co. 97
LeBlond Mch. Tool Co., R. K. 37-42-43
Niles-Bement-Pond Co...68-69-153
Potter & Johnston Mch. Co... 60
Reed Co., F. E. 59
Warner & Swasey Co. 83
Whitcomb-Blaisdell Mch. Tool Co. 99
Windsor Mch. Co. 85

Chucks, Drill
Almond Mfg. Co., T. R.....177
Cleveland Twist Drill Co., 31-70-Back cover
Cushman Chuck Co. 176
Horton & Son Co., E. 175
Jacobs Mfg. Co. 179
Modern Tool Co. 174
Morrow Mfg. Co. 174
Morse Twist Drill & Mch. Co.100
Niles-Bement-Pond Co...68-69-153
Oneida National Chuck Co....175
Pratt Chuck Co. 176
Skinner Chuck Co.....178
Standard Tool Co. 55
Union Mfg. Co. 175
Wells Bros. Co. 92
Westcott Chuck Co. 175
Whitman & Barnes Mfg. Co...149
Whitney Mfg. Co. 123
Whiton Mch. Co., D. E.....134
Wiley & Russell Mfg. Co..... 92

Chucks, Lathe
Cincinnati Chuck Co. 178
Cushman Chuck Co. 176
Gisholt Mch. Co. 97
Hoggson & Pettis Mfg. Co...175
Horton & Son Co., E. 175
Horton Machine Co., S. E.....174
Niles-Bement-Pond Co...68-69-153
Pratt Chuck Co. 176
Skinner Chuck Co.....178
Union Mfg. Co. 175
Whiton Mch. Co., D. E. 134

Chucks, Magnetic
Walker & Co., O. S....Back cover

Chucks, Planer
Cincinnati Planer Co. 19
Harrington & Son Co., Edwin.127
New Haven Mfg. Co.....135
Niles-Bement-Pond Co...68-69-153
Skinner Chuck Co.....178
Union Mfg. Co. 175

Chucks, Split
Hardinge Bros. 192
Rivett Lathe Mfg. Co.....194
Stark Tool Co. 188

Circuit Breakers
General Electric Co.....141
Westinghouse Elec. & Mfg. Co.142

Clamps
Brown & Sharpe Mfg. Co..... 71
Hammacher, Schlemmer & Co.. 77
Hoggson & Pettis Mfg. Co.....175
Starrett Co., L. S. 93
Williams & Co., J. H. 86

Clocks, Watchmen's
Hardinge Bros. 192

Clutches, Friction
American Twist Drill Co.....124
Bliss Co., E. W. 187
Caldwell & Son Co., H. W.....155
Edgemont Mch. Co., ...126
Evans, G. F. 184
Johnson Mch. Co., Carlyle... 83
New Haven Mfg. Co.....135
Oesterlein Mch. Co. 18
Reeves Pulley Co. 149
Williams Fdry. & Mch. Co...124
Wood's Sons Co., T. B..... 51

Cold Saw Cutting-off Machines
Billings & Spencer Co..... 70
Burr & Sons, John T. 189
Espen-Lucas Mch. Wks.....181

Compressors, Air
Curtis & Co., Mfg. Co.....156
Dallett Co., Thos. H.....183
Ingersoll-Rand Co. 125
Ryerson & Son, Jos. T. 54A-54B
Spacke Mch. Co., F. W.....156

Compressors, Gas
Ingersoll-Rand Co. 125

Conduit, Interior
Sprague Electric Co. 44

Cones, Friction
Evans, G. F. 184

Connecting Rods and Straps
Elec. Welding Products Co...139

Contract Work
Blanchard Machine Co..... 52
Morrow Mfg. Co. 174
Owen Machine Tool Co. 85

Controllers
Crocker-Wheeler Co. 143
Eck Dynamo & Motor Co. 140
General Electric Co. 141
Reliance Elect. & Eng. Co.....140
Roth Bros. & Co.....155
Sprague Electric Co..... 44

Corundum
See Grinding Wheels.

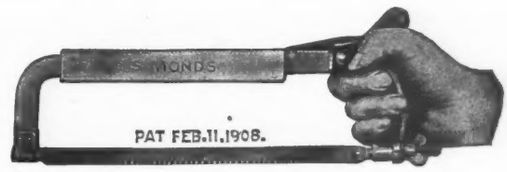
Cotters
Cleveland Twist Drill Co., 31-70-Back cover
Morse Twist Drill & Mch. Co..100
Standard Tool Co. 55
Union Twist Drill Co. 29
Whitman & Barnes Mfg. Co..149

Counterbores
Cleveland Twist Drill Co., 31-70-Back cover
Morse Twist Drill & Mch. Co..100
Pratt & Whitney Co. 4-5
Slocomb Co., J. T.....151
Starrett Co., L. S. 93

Counters, Revolution
Grant Mfg. & Machine Co..... 70
Root Co., C. J.....152
Veeder Mfg. Co.....189

Countershafts
Almond Mfg. Co., T. R.....177
Builders' Iron Fdry..Back cover
Brown & Sharpe Mfg. Co..... 71
Coates Clipper Mfg. Co..... 90
Dill Mch. Co., T. C.....122
Evans, G. F. 184
Garvin Machine Co. 52
LeBlond Mch. Tool Co., R. K. 37-42-43
Norton Grinding Co.....106
Safety Emery Wheel Co.....110

Countershafts, Friction
Dill Mch. Co., T. C.....122
Evans, G. F.....184
Wilmarth & Morman Co.....112



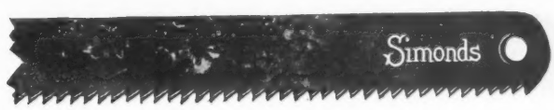
Lend a man your Simonds Frame

and he will ask to try your Simonds Blade.

It's the inevitable result for the convenience and strength of this frame suggests the quality of Simonds Hack Saws —saws which are made for men who are wise enough to economize by taking care of the little leaks in shop expenses.

We can cut your yearly Hack Saw bills in half on quantities.

Get into correspondence with us.



Simonds Manufacturing Co.

Fitchburg, Mass. Chicago, Ill. Montreal, Que. New York City
New Orleans, La. San Francisco, Cal. Seattle, Wash. Portland, Ore.
8 White Street, Moorfields, London, E. C., Eng.

TAPS, DIES AND SCREW PLATES

BUTTERFIELD & CO., Derby Line, VERMONT

The Bêché Hammer

Hammer and Compressor Combined

The Peer of Forge Hammers

Belt or Motor Drive

NAZEL ENGINEERING and MACHINE WORKS

5th & Luzerne Sts., Philadelphia

Sole Manufacturers for United States

Illustration shows 250 lb. Hammer Belt Driven

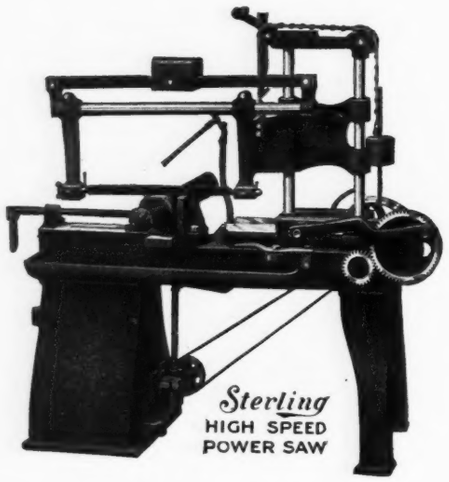
Other sizes 66, 110, 165, 330, 500 and 770 lbs.

Write for Catalog.

"S-T-E-R-L-I-N-G"

HACK-SAW-MACHINES

HAVE PROVED THEIR SUPERIORITY BY ACTUAL TEST



Write for particulars.

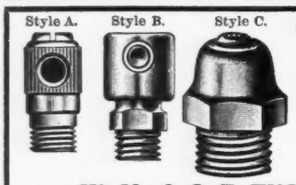
Manufactured by

DIAMOND SAW AND STAMPING WORKS

BUFFALO, N. Y., U. S. A.

FOREIGN OFFICES: 124 Holborn, London, E. C., Eng. Pickhuben 4, Freihafen, Hamburg, Germany. Hardware Chambers, Melbourne, Australia. 1a Calle de Dolores No. 10, Mexico City, Mexico.

Style A. Style B. Style C.



OIL HOLE COVERS

Is our Special Line of Manufacture

SEND YOUR OILING PROBLEMS TO US
WE WILL QUOTE ON SPECIAL DESIGNS
IF YOU CANNOT FIND WHAT YOU WANT

In our Catalogue

W. M. & C. F. TUCKER, Hartford, Conn.

PACIFIC COAST AGENT—C. Ducommun, Los Angeles, Cal. FOREIGN AGENTS—Fenwi c Freres & Co., Paris, France. G. W. Burton, Griffiths & Co., London, Eng.

THE PHOSPHOR BRONZE SMELTING CO.

2200 Washington Ave., Philadelphia, Pa.

ELEPHANT BRAND

DELTA
REG. U. S. PAT. OFF.

ELEPHANT BRAND "Phosphor-Bronze"
INGOTS, CASTINGS, WIRE, SHEETS, RODS, Etc.

DELTA METAL
IN BARS FOR FORGING AND FINISHED RODS

Original and Sole Makers in the U. S.

Counting Machines
Recording Register & Fare Box Co. 189
Root Co., C. J. 152
Veeder Mfg. Co. 189

Couplers, Hose
Greene, Tweed & Co. 96
Ingersoll-Rand Co. 125

Couplings
Almond Mfg. Co., T. R. 177
Caldwell & Son Co., H. W. 155
Davis Machine Co., W. P. 53
National Tube Co. 164
Nicholson & Co., W. H. 171
Sellers & Co., Inc., Wm. 98
Standard Gauge Steel Co. 97

Cranes
Box & Co., Alfred 126
Brown Hoisting Mchy. Co. 126
Curtis & Co., Mfg. Co. 156
Manning, Maxwell & Moore, Inc. 102
Maris Bros. 126
Niles-Bement-Pond Co. 68-69-153
Northern Engineering Works. 127
Obermayer Co., S. 150
Pawling & Harnischfeger Co. 145
Sellers & Co., Inc., Wm. 98
Shepard Electric Crane & Hoist Co. 127
Toledo-Massillon Bridge Co. 127
Vandyck Churchill Co. 186
Yale & Towne Mfg. Co. 129

Crank Pin Turning Machines
Niles-Bement-Pond Co. 68-69-153
Ryerson & Son, Jos. T. 54A-54B
Underwood Co., H. B. 145

Crucibles
Dixon Crucible Co., Jos. 183
McCullough-Dalzell Crucible Co. 194
Obermayer Co., S. 150

Cupolas and Ladles, Foundry
Northern Engineering Wks. 127
Obermayer Co., S. 150

Cut Meters
Warner Instrument Co. 140

Cutters, Milling
Adams Co. 161
Becker Milling Machine Co. .. 78
Boker & Co., Hermann 131
Brown & Sharpe Mfg. Co. 71
Cleveland Twist Drill Co., 31-70-Back cover
Ingersoll Milling Machine Co. 22
Kearney & Trecker 10
Morse Twist Drill & Mch. Co. 100
Owen Mch. Tool Co. 85
Pratt & Whitney Co. 4-5
Standard Tool Co. 55
Tabor Mfg. Co. 101
Union Twist Drill Co. 29
Ward & Sons, Edgar T. 164
Whitney Mfg. Co. 123

Cutting-off Machines
Armstrong Bros. Tool Co. 121-150
Bignall & Keeler Mfg. Co. 191
Brown & Sharpe Mfg. Co. 71
Davis Machine Co., W. P. 53
Espen-Lucas Mch. Wks. 181
Fox Machine Co. 67
Hurlbut-Rogers Mch. Co. 194
Lea Equipment Co. 172
McCabe, J. J. 24-152
Newton Mch. Tool Wks., Inc. 61
Pratt & Whitney Co. 4-5
Prentiss Tool & Supply Co. .. 56
Sellers & Co., Inc., Wm. 98
Vandyck Churchill Co. 186
Warner & Swasey Co. 83

Cutting-off Tools
Armstrong Bros. Tool Co. 121-150
Billings & Spencer Co. 70
Cleveland Twist Drill Co., 31-70-Back cover
O. K. Tool Holder Co. 189
Pratt & Whitney Co. 4-5

Cyclometers
Veeder Mfg. Co. 189

Diamond Tools
Abrasive Material Co. 104
American Emery Wheel Wks. 110
Calder, Geo. H. 113
Desmond-Stephan Mfg. Co. 112
Safety Emery Wheel Co. 110

Dies, Sheet Metal
Bliss Co., E. W. 187
Ferracute Mch. Co. 166
New Haven Mfg. Co. 135
Pratt & Whitney Co. 4-5
Swaine Mfg. Co., F. J. 187
Waltham Machine Works. 159

Dies, Sub-Press
Pratt & Whitney Co. 4-5
Waltham Machine Works. 159

Dies, Threading, Opening
Bickford & Washburn 173
Boker & Co., Hermann 131
Geometric Tool Co. 113
Jones & Lamson Mch. Co. 16-17
Landis Mch. Co., Inc. 44
Modern Tool Co. 174
Pratt & Whitney Co. 4-5
Wells Bros. Co. 92

Drafting Machines
Keuffel & Esser Co. 151

Drawing Boards and Tables
Fritz Mfg. Co. 189
Keuffel & Esser Co. 151
Washburn Shops 150

Drawing Materials
Keuffel & Esser Co. 151

Drill Sockets
American Specialty Co. 189
Cleveland Twist Drill Co., 31-70-Back cover
Morse Twist Drill & Mch Co. 100
Standard Tool Co. 55

Drill Speeders
Graham Mfg. Co. 192

Drilling Machines, Bench
Barnes Co., W. F. & John 33
Burke Mchy. Co. 50
Hoefer Mfg. Co. 137
Pratt & Whitney Co. 4-5
Prentice Bros. Co. Inside back cover
Rockford Drilling Mch. Co. 117
Rockford Lathe & Drill Co. 88
U. S. Electrical Tool Co. 66

Drilling Machines, Boiler
American Tool Works Co. 14
Cincinnati Bickford Tool Co. 26
Niles-Bement-Pond Co. 68-69-153
Prentice Bros Co., Inside back cover
Sellers & Co., Inc., Wm. 98

Drilling Machines, Multiple Spindle
American Tool Wks. Co. 14
Baker Bros. 144
Barr, H. G. 136
Barnes Co., W. F. & John 33
Barnes Drill Co., Inc. 136
Baush Mch. Tool Co. 8
Cincinnati Bickford Tool Co. .. 26
Cincinnati Pulley Mchy. Co. .. 116
Flather Planer Co., Mark 144
Fosdick Mch. Tool Co. 118
Fox Mch. Co. 67
Garvin Machine Co. 52
Hardinge Bros. 192
Harrington, Son & Co., Edwin. 127
Henry & Wright Mfg. Co. 87
Hill, Clarke & Co., Inc. 80-81
Hoefer Mfg. Co. 137
Kern Mch. Tool Co. 67
Moline Tool Co. 136
Newton Mch. Tool Works, Inc. 61
Niles-Bement-Pond Co. 68-69-153
Pratt & Whitney Co. 4-5
Prentice Bros. Co., Inside back cover
Prentiss Tool & Supply Co. .. 56
Quint, A. E. 48
Reed Co., Francis 155
Rockford Drilling Mch. Co. 117
Rockford Lathe & Drill Co. 88
Seners & Co., Inc., Wm. 98
Slate Mch. Co., Dwight 116
Taylor & Fenn Co. 84

Drilling Machines, Portable
Coates Clipper Mfg. Co. 90
Dallett, Thos. H. 183
General Electric Co. 141
Hisey-Wolf Mch. Co. 143
Ingersoll-Rand Co. 125
Newton Mch. Tool Wks., Inc. 61
Niles-Bement-Pond Co. 68-69-153
Stow Flexible Shaft Co. 166
U. S. Electrical Tool Co. 66
Van Dorn & Dutton Co. 143-160

Drilling Machines, Radial
American Tool Works Co. 14
Baush Mch. Tool Co. 8
Cincinnati Bickford Tool Co. 26
Detrick & Harvey Mch. Co. 145
Dreses Mch. Tool Co. 23
Fitchburg Machine Works. 89
Fosdick Mch. Tool Co. 118
Gang Co., Wm. E. 144
Hamilton Mch. Tool Co. 34
Harrington, Son & Co., Edwin. 127
Morris Mch. Tool Co., Jno. B. 180
Mueller Mch. Tool Co. 86
Newton Mch. Tool Wks., Inc. 61
Niles-Bement-Pond Co. 68-69-153
Prentice Bros. Co., Inside back cover
Sellers & Co., Inc., Wm. 98

Drilling Machines, Rail
Newton Mch. Tool Wks., Inc. 61
Niles-Bement-Pond Co. 68-69-153
Sellers & Co., Inc., Wm. 98
Standard Tool Co. 55

Drilling Machines, Turret
Fay Machine Tool Co. 118
Niles-Bement-Pond Co. 68-69-153
Quint, A. E. 48

Drilling Machines, Upright
Baker Bros. 144
Barnes Co., W. F. & John 33
Barnes Drill Co., Inc. 136
Barr, H. G. 136
Beaman & Smith Co. 15-173
Cincinnati Bickford Tool Co. 26
Davis Machine Co., W. P. 53
Fosdick Mch. Tool Co. 118
Fox Mch. Co. 67
Garvin Machine Co. 52
Gould & Eberhardt 161
Hamilton Machine Tool Co. 34
Harrington Son & Co., Edwin. 127
Henry & Wright Mfg. Co. 87
Hill, Clark & Co., Inc. 80-81
Hoefer Mfg. Co. 137
Kern Mch. Tool Co. 67
Knight Mchy. Co., W. B. 156

Mechanics Mch. Co. 136
Miami Valley Mch. Tool Co..112
Morse Twist Drill & Mch. Co.100
New Haven Mfg. Co. 135
Niles-Bement-Pond Co...68-69-153
Pratt & Whitney Co..... 4-5
Prentice Bros. Co.,
Inside back cover
Rockford Drilling Mch Co....117
Rockford Lathe & Drill Co... 88
Ryerson & Son, Jos. T..54A-54B
Sellers & Co., Inc., Wm..... 98
Sibley Machine Tool Co. 119
Slate Mch Co., Dwight.....116
Snyder & Son, J. E..... 3
Taylor & Fenn Co. 84
Washburn Shops 150
Whitney Mfg. Co. 123
Wiley & Russell Mfg. Co..... 92

Drills, Center
Cleveland Twist Drill Co.,
31-70-Back cover
Morse Twist Drill & Mch. Co..100
Pratt & Whitney Co..... 4-5
Slocomb Co., J. T.....151
Standard Tool Co..... 55

Drills, Electric
General Electric Co.....141
Hisey-Wolf Mch. Co.....143
Niles-Bement-Pond Co...68-69-153
United States Elec. Tool Co.. 66
Van Dorn & Dutton Co..143-160

Drills, Flat
Whitman & Barnes Mfg. Co..149

Drills, Hand
Coates Clipper Mfg. Co..... 90
Ingersoll-Rand Co. 125
Niles-Bement-Pond Co...68-69-153
U. S. Electrical Tool Co..... 66

Drills, Pneumatic
Ingersoll-Rand Co. 125

Drills, Ratchet
Armstrong Bros. Tool Co.121-150
Billings & Spencer Co..... 70
Boker & Co., Hermann.....131
Cleveland Twist Drill Co.,
31-70-Back cover
Greene, Tweed & Co. 96
Pratt & Whitney Co. 4-5
Standard Tool Co. 55

Drills, Rock
Ingersoll-Rand Co.....125

Drills, Wall Radial
Ryerson & Son, Jos. T..54A-54B

Drying Apparatus
Sturtevant Co., B. F.....38

Drying Ovens
Steiner, E. E. 184

Dynamos
Crocker-Wheeler Co. 143
Eck Dynamo & Motor Co.....140
Fort Wayne Elec. Works....142
General Elec. Co. 141
Reliance Elect. & Eng. Co....140
Roth Bros. & Co. 155
Sprague Electric Co. 44
Sturtevant Co., B. F..... 38
Wagner Elec. Mfg. Co. 142
Westinghouse Elec. & Mfg. Co.142

Electrical Supplies
General Electric Co. 141
Roth Bros. & Co.....155
Westinghouse Elec. & Mfg. Co.142

Electrotypers
Lovejoy Co. 180

Emery and Corundum Wheels
Abrasive Material Co. 104
American Emery Wheel Wks..110
Safety Emery Wheel Co. 110
Sterling Emery Wheel Mfg. Co. 112
Vitrified Wheel Co. 108

Emery Wheels
See Grinding Wheels.

Emery Wheel Dressers
Abrasive Material Co. 104
American Emery Wheel Wks.110
Calder, Geo. H. 113
Desmond-Stephan Mfg. Co....112
Reed Mfg. Co. 180
Safety Emery Wheel Co.....110
Standard Tool Co..... 55
Vitrified Wheel Co. 108

Engines
New Britain Mch. Co. 173
Sturtevant Co., B. F..... 38

Engines, Gas and Gasoline
Automatic Mch. Co.....154
Foos Gas Engine Co. 150
Grant Mfg. & Mch Co..... 70
Otto Gas Engine Works.....183
Racine Tool & Mch. Co. 172

Engines, Steam
Buckeye Engine Co. 146
Nazel Eng. & Mch. Wks. 39
Sturtevant Co., B. F. 38

Engraving Machinery
Gorton Mch. Co., Geo.....173

Exhaust Heads
Sturtevant Co., B. F..... 38

Expanders, Tube
Nicholson & Co., W. H.....171
Pratt & Whitney Co. 4-5
Watson-Stillman Co. 128

Factory Equipment
Terrell's Equipment Co. 138
Van Dorn Iron Works Co.....138

Fans, Exhaust, Electric, Ventilating
Crocker-Wheeler Co. 143
Eck Dynamo & Motor Co.....140
General Electric Co. 141
Reliance Elect. & Eng. Co....140
Roth Bros. & Co. 155
Sturtevant Co., B. F. 38
Westinghouse Elec. & Mfg. Co.142

Ferro-Vanadium
American Vanadium Co. 27

Files and Rasps
American Swiss File & Tool Co. 87
Barnett Co., G & H..Back cover
Carver File Co. .....Back cover
Hammacher, Schlemmer & Co.. 77
Hayes File Co. 150
Nicholson File Co. 25
Reichhelm & Co., E. P..... 87
Simonds Mfg. Co. 39

Filing Machines
Detrick & Harvey Mch. Tool Co. 145
Henry & Wright Mfg. Co..... 87
Robinson Tool Works.....113

Fillet Cutters
Milwaukee Fdry. Supply Co...113

Fillet (Leather)
Butler, A. G. 164

Fittings, Hydraulic
National Tube Co. 164
Watson-Stillman Co. 128

Fittings, Iron
National Tube Co. 164

Fittings, Steam
National Tube Co. 164
Walworth Mfg. Co. 3

Flanges
National Tube Co. 164

Flexible Shafts
Coates Clipper Mfg. Co. 90
Stow Flexible Shaft Co. 166
Stow Mfg. Co. 181

Forges
Billings & Spencer Co..... 70
Burke Mchy. Co. 50
National Machinery Co. 63
Rockwell Furnace Co.....133
Sturtevant Co., B. F. 38

Forging Machines
Acme Machinery Co..... 45
Ajax Mfg. Co. 79
Beaudry & Co. 185
Bliss Co., E. W. 187
National Mchy. Co. 63
Scranton & Co. 184
Williams, White & Co. 186

Forgings, Drop
Billings & Spencer Co. 70
Hay-Budden Mfg. Co. 49
Machinery Forging Co. 113
Phosphor Bronze Smelting Co. 40
Williams & Co., J. H..... 86
Wyman & Gordon Co.....182

Forgings, Vanadium
American Vanadium Co. 27

Foundry Furnishings
Adams Co. 161
Goldschmidt Thermit Co. 47
Ingersoll-Rand Co. 125
Milwaukee Foundry Supply Co. 113
Obermayer Co., S. 150
Rockwell Furnace Co. 133
Sturtevant Co., B. F..... 38

Fuel Economizers
Sturtevant Co., B. F..... 38

Furnaces, Annealing and Tempering
American Gas Furnace Co....134
Brown & Sharpe Mfg. Co..... 71
Chicago Flexible Shaft Co....132
General Electric Co. 141
Rockwell Co., W. S. 180
Rockwell Furnace Co. 133

Furnaces, Coal and Oil
Rockwell Co., W. S. 180
Rockwell Furnace Co.....133

Furnaces, Electric
General Electric Co. 141
Obermayer Co., S. 150

Furnaces, Gas
American Gas Furnace Co. ..134
Chicago Flexible Shaft Co. ..132
Rockwell Co., W. S. 180
Rockwell Furnace Co. 133

Furnaces, Melting
American Gas Furnace Co. ..134
Chicago Flexible Shaft Co. ..132
Rockwell Furnace Co. 133

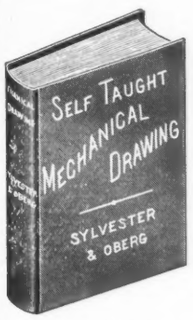
Furnaces, Welding
Rockwell Furnace Co. 133
Toledo Electric Welder Co... 95

Gages, Recording
Bristol Co. .....Back cover

Gages, Steam
Bristol Co. .....Back cover

Gages, Surface, Depth, etc.
Brown & Sharpe Mfg. Co.... 71
Cleveland Twist Drill Co.,
31-70-Back cover

THERE'S A NEW BOOK—JUST ISSUED!



SELF-TAUGHT

MECHANICAL DRAWING

AND ELEMENTARY MACHINE DESIGN

By F. L. SYLVESTER, M. E.

With Additions by ERIK OBERG, Associate Editor of "Machinery"

330 Pages. Illustrated by 215 Engravings. PRICE $2.00

This is a practical treatise on Mechanical Drawing and Machine Design, comprising the first principles of geometric and mechanical drawing, workshop mathematics, mechanics, strength of materials and the calculations and design of machine details. Specially prepared for the practical mechanic and young draftsman. It is primarily intended for the man who must study without a teacher. It is clearly written, comprehensive, and carefully arranged. The thorough manner in which the subject is treated is best understood from a study of the Table of Contents below.

Among the Contents are Chapters on:

I. Instruments and Materials:—General Remarks on the Study of Drawing—Drawing Instruments—Pencils—Use of the Instruments—Paper—Ink.

II. Definitions of Terms used in Geometrical and Mechanical Drawing: — Point — Line—Surface — Solid — Plane—Angle — Circle — Parallelogram — Polygon—Ellipse—Involute—Cycloid —Parabola.

III. Geometrical Problems: — Bisecting of Lines and Angles—Perpendicular Lines—Tangents —Regular Polygons—Inscribed and Circumscribed Circles — Ellipses—Spirals — Involutes — Cycloids—Parabolas.

IV. Projection:—Mode of Representing Objects—Projections of Inclined Prisms—Surface Developments of Cones and Pyramids — Intersecting Cylinders, and Cylinder and Cone—Projection of a Helix—Isometric Projection.

V. Working Drawings: — Object of Working Drawings—Assembly Drawings—Detail Drawings — Dimensions — Finish Marks—Sectional Views—Cross-section Chart—Screw Threads — Shade Lines — Tracing and Blue-printing.

VI. Algebraic Formulas: — The Meaning of Formulas—Square and Square-root — Cube and Cube Roots—Exponents—Areas and Volumes of Plane Figures and Solids.

VII. Elements of Trigonometry: —Angles — Right-angled Triangles—Trigonometrical Functions—Tables of Natural Functions—Solution of Right-angled Triangles—Solutions of Oblique-angled Triangles—Laying out Angles by means of Trigonometric Functions.

VIII. Elements of Mechanics:—Resolution of Forces—Levers—Fixed and Movable Pulleys—Inclined Planes—The Screw—Differential Screw — Newton's Laws of Motion—Pendulum—Falling Bodies — Energy and Work—Horse-power of Steam Engines.

IX. First Principles of Strength of Materials:—Factor of Safety —Shape of Machine Parts—Strength of Materials as given by Kirkaldy's Tests—Stresses in Castings.

X. Cams: — General Principles—Design of Cams imparting Uniform Motion — Reciprocating Cams — Cams Providing Uniform Return—Uniformly Accelerated Motion Cams—Gravity Cam Curve—Harmonic Action Cams — Approximate Gravity Cam Curve.

XI. Sprocket Wheels:—Object of Sprocket Wheels—Drafting of Sprocket Wheels for Different Classes of Chain—Speed Ratio.

XII. General Principles of Gearing: — Friction and Knuckle Gearing—Epicycloidal Gearing — Gears with Strengthened Flanks — Gears with Radial Flanks—Involute Gears—Interference in Involute Gears—The Two Systems Compared—Twenty-degree Involute Gears—Shrouded Gears—Bevel Gears—Worm Gearing—Circular Pitch —Proportion of Teeth—Diametrical Pitch — The Hunting Tooth—Approximate Shapes for Cycloidal Gear Teeth—Involute Teeth—Proportions of Gears—Strength of Gear Teeth—Thurston's Rule for Gear Shafts—Speed-Ratio of Gearing.

XIII. Calculating the Dimensions of Gears:—Spur Gearing —Bevel Gears—Worm Gearing.

XIV. Cone Pulleys: — Conical Drums — Influence of Crossed Belt — Cone Pulleys — Smith's Rule for Laying Out Cone Pulleys.

XV. Bolts, Studs and Screws:—Kinds of Screws—United States Standard Screw Thread Check or Lock Nuts—Bolts to Withstand Shock—Wrench Action—Screws for Power Transmission —Efficiency of Screws—Acme Standard Thread — Miscellaneous Screw Thread Systems—Other Commercial Forms of Screws.

XVI. Couplings and Clutches:—Simple forms of Couplings—Calculation of Flange Coupling Bolts — Oldham's Coupling — Hooke's Coupling or Universal Joint—Toothed Clutches—Friction Clutches—Cone Clutches.

XVII. Shafts, Belts and Pulleys:—Calculation of Shafting — Horse-power of Belting — Speed of Belting—Pulley Sizes and Speed Ratios—Twisted and Unusual Cases of Belting.

XVIII. Fly-wheels for Presses, Punches, etc.:—Object of Fly-wheels—Formulas for Fly-wheel Calculations—Example of Fly-wheel Calculation for Shears.

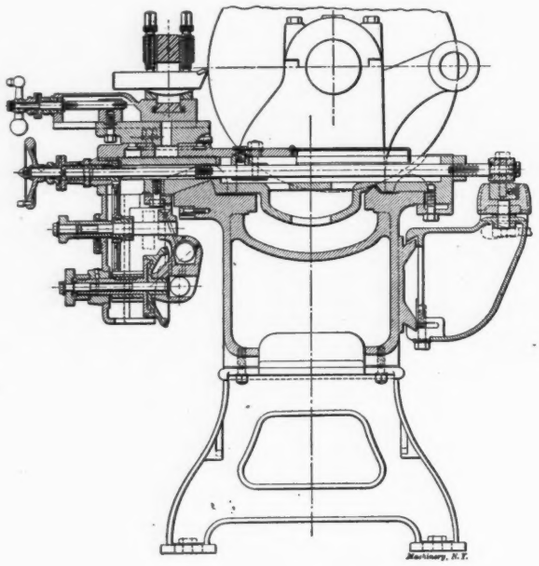
XIX. Trains of Mechanism:—To Secure Increase of Speed—To Secure Reversal of Direction—The Compound Idler — The Screw Cutting Train — Simplified Rules for Calculating Lathe Change Gears — Back Gears.

XX. Quick Return Motions:—Object of Quick Return Motions—Examples of Simple Designs of Quick Return Motions —The Whitworth Quick Return Device—The Elliptic Gear Quick Return.

FREE New Practical Book Catalogue sent FREE on request. All latest books included. Send us your name and address and receive it by return mail.

☞ Any of the above books sent prepaid on receipt of price.

NORMAN W. HENLEY & SON, 132 Nassau Street, New York



The Tool Support

You have often noticed your Lathes chatter when operating on work of large diameter, even under reduced feed and speed.

This is the result of poor tool support, caused by the tool overhanging the bed.

The tool never overhangs the bed on our Heavy Duty Lathes, even when working at the maximum swing.

This means the same efficient feed and speed on the large diameters, and the resulting reduction in cost.

Besides the great advantage of proper tool support, this construction permits an increased swing over the carriage.

Write us for other exclusive LeBlond cost-reducing features.

THE R. K. LEBLOND MACHINE TOOL COMPANY

CINCINNATI, OHIO, U. S. A.

Henry Wright Mfg. Co. 87
Marbach Co., F. G. 113
Morse Twist Drill & Mch. Co..100
Pratt & Whitney Co. 4-5
Rogers Wks., Inc., John M..174
Sawyer Tool Mfg. Co. 165
Slocomb Co., J. T.....151
Smith Co., E. G. 173
Starrett Co., L. S. 93
Wells Bros. Co. 92
Wyke & Co., J. 164

Gaskets
Greene, Tweed & Co. 96

Gear Cutting Machinery
Adams Co. 161
Becker Milling Mch. Co..... 78
Bilgram Machine Wks. 158
Brown & Sharpe Mfg. Co.... 71
Carpenter-Kerlin Gear & Mch. Co. 86
Cincinnati Gear Cutting Machine Co. 20
Cincinnati Shaper Co..... 20
Earle Gear & Mch. Co.....158
Fellows Gear Shaper Co.... 32
Flather Mfg. Co., E. J..... 50
Gleason Works
Front cover-Back cover
Gould & Eberhardt.....161
Harrington, Son & Co., Edwin.127
Lees-Bradner Co. 157
Newark Gear Cutting Machine Co. 157
Newton Machine Tool Wks., Inc. 61
Niles-Bement-Pond Co...68-69-153
Pratt & Whitney Co. 4-5
Reynolds Mchy. Co. 128
Schuchardt & Schutte 157
Spacke Mch. Co., F. W.....156
Van Dorn & Dutton Co. ..143-160
Walcott & Wood Mch. Tool Co..198
Waltham Machine Works....159
Whiton Machine Co., D. E.....134

Gear Planers, Bevel
Gleason Works
Front cover-Back cover

Gear Shapers
Fellows Gear Shaper Co..... 32

Gear Testing Machinery
Gisholt Mch. Co. 97
Morse Twist Drill & Mch. Co..100

Gears, Cut
Adams Co. 161
American Vanadium Co. 27
Bilgram Machine Wks.....158
Boston Gear Works 159
Brown & Sharpe Mfg. Co.... 71
Caldwell & Son Co., H. W....155
Carpenter-Kerlin Gear & Mch. Co. 86
Cincinnati Milling Mch. Co.. 73
Cullman Wheel Co.....158
Davis, Rodney 158
Earle Gear & Machine Co...158
Fellows Gear Shaper Co. 32
Flather Mfg. Co., E. J..... 50
Foote Bros. Gear & Mch. Co..160
Ganschow Co., Wm.....158
Gleason Works
Front cover-Back cover
Gould & Eberhardt 161
Grant Gear Works 158
Hardinge Bros. 192
Harrington, Son & Co., Edwin.127
Horsburgh & Scott Co. 160
Lea Equipment Co. 172
Morse, Williams & Co.....162
Newark Gear Cutting Machine Co. 157
New England Gear Works ..155
New Process Rawhide Co.162-163
Nuttall Co., R. D.....160
Owen Machine Tool Co..... 85
Philadelphia Gear Works, Inc.159
Quride Co.....158
Spacke Mch. Co., F. W.....156
Taylor-Wilson Mfg. Co.,
Inside front cover
Van Dorn & Dutton Co...143-160
Walcott & Wood Mch. Tool Co. 98

Gears, Molded
Caldwell & Son Co., H. W....155
Franklin Mfg. Co. 188
Horsburgh & Scott Co. 160
Philadelphia Gear Works, Inc.159
Taylor-Wilson Mfg. Co.,
Inside front cover
Van Dorn & Dutton Co..143-160

Gears, Quride
Quride Co. 158

Gears, Rawhide
Boston Gear Works 159
Earle Gear & Machine Co.....158
Foote Bros. Gear & Mch. Co...160
Ganschow Co., Wm. 158
Gould & Eberhardt 161
Grant Gear Works 158
Horsburgh & Scott Co. 160
New Process Rawhide Co.162-163
Nuttall Co., R. D. 160
Philadelphia Gear Works, Inc.159
Van Dorn & Dutton Co..143-160

Gears, Worm
Boston Gear Works 159
Brown & Sharpe Mfg. Co.... 71
Carpenter-Kerlin Gear & Mch. Co. 86
Cincinnati Gear Cutting Mch. Co. 20
Earle Gear & Machine Co....158

Foote Bros. Gear & Mch. Co..160
Ganschow Co., Wm. 158
Gould & Eberhardt.....161
Horsburgh & Scott Co. 160
Morse, Williams & Co. 162
Newark Gear Cutting Machine Co. 157
Nuttall Co., R. D. 160
Philadelphia Gear Works, Inc.159
Quride Co. 158
Taylor-Wilson Mfg. Co. Inside front cover
Van Dorn & Dutton Co..143-160

Generators
Crocker-Wheeler Co. 143
Eck Dynamo & Motor Co. ..140
Fort Wayne Elec. Works.....142
General Electric Co. 141
Reliance Elect. & Eng. Co....140
Roth Bros. & Co. 155
Sprague Electric Co. 44
Wagner Electric Mfg. Co.....142

Generators, Gas
American Gas Furnace Co. ..134

Graphite
Dixon Crucible Co., Jos.....183

Grinders, Bench
Diamond Machine Co..Back cover
Walker & Co., O. S....Back cover

Grinders, Center
Coates Clipper Mfg. Co. 90
Diamond Machine Co..Back cover
Greenfield Machine Co. 102
Mueller Machine Tool Co..... 86
Niles-Bement-Pond Co...68-69-153
Trump Bros. Mch. Co.....173
U. S. Electrical Tool Co..... 66

Grinders, Chucking
Bryant Chucking Grinder Co..114
Pratt & Whitney Co.....4-5

Grinders, Cutter
Bath Grinder Co. 108
Becker Milling Mch. Co..... 78
Brown & Sharpe Mfg. Co.... 71
Cincinnati Milling Mch. Co... 73
Garvin Machine Co. 52
Gould & Eberhardt.....161
Greenfield Machine Co. 102
Heald Mch. Co.....103
Ingersoll Milling Mch. Co..... 22
LeBlond Mch. Tool Co., R. K., 37-42-43
Modern Tool Co. 174
Niles-Bement-Pond Co...68-69-153
Norton Grinding Co. 106
Oesterlein Mch. Co. 18
Pratt & Whitney Co. 4-5
Rivett Lathe Mfg. Co. 194
U. S. Electrical Tool Co. 66
Wells & Son Co., F. E. 104
Wilmarth & Morman Co. 112

Grinders, Cylindrical
Bath Grinder Co.....108
Brown & Sharpe Mfg. Co.... 71
Greenfield Machine Co. 102
Heald Mch. Co.....103
Landis Tool Co. 109
Morse Twist Drill & Mch. Co..100
Norton Grinding Co. 106

Grinders, Disc
Bath Grinder Co. 108
Besly & Co., Chas. H.....105
Diamond Machine Co..Back cover
Gardner Machine Co.....110
Heald Mch. Co. 103
Hoysradt & Case 52
Ransom Mfg. Co. 111
Safety Emery Wheel Co.....110
Taylor & Fenn Co. 84
Valley City Mch. Wks.....112

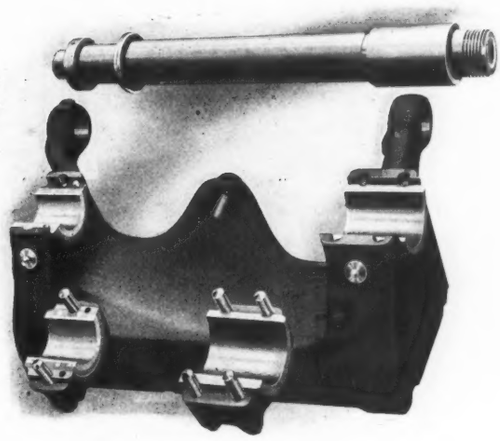
Grinders, Drill
Heald Mch. Co. 103
Morse Twist Drill & Mch. Co..100
Niles-Bement-Pond Co..68-69-153
Robinson Tool Works.....113
Safety Emery Wheel Co. 110
Sellers & Co., Inc., Wm. 98
Standard Tool Co. 55
U. S. Electrical Tool Co. 66
Washburn Shops 150
Wilmarth & Morman Co. 112

Grinders, Internal
Bath Grinder Co. 108
Brown & Sharpe Mfg. Co.... 71
Diamond Machine Co.Back cover
Greenfield Machine Co.....102
Heald Mch. Co. 103
Landis Tool Co. 109
Modern Tool Co. 174
Niles-Bement-Pond Co..68-69-153
Rivett Lathe Mfg. Co. 194
U. S. Electrical Tool Co. 66

Grinders, Knife
American Twist Drill Co. 124
Safety Emery Wheel Co. 110

Grinders, Electric, Portable
Coates Clipper Mfg. Co. 90
General Electric Co. 141
Hisey-Wolf Mch. Co.....143
Niles-Bement-Pond Co..68-69-153
U. S. Electrical Tool Co. 66

Grinders, Tool
Armstrong Bros. Tool Co.121-150
Barnes Co., W. F. & John... 33
Bath Grinder Co. 108
Brown & Sharpe Mfg. Co.... 71
Cincinnati Milling Mch. Co...73
Diamond Machine Co..Back cover
Gisholt Mch. Co. 97
Gould & Eberhardt.....161



The Spindle Bearings

The ideal bearing is one that will run forever, without wear or attention.

Our spindle bearings are not ideal, but nearer to it than any bearing ever used on a Lathe before.

The journal is hardened and ground, and runs in a special cast iron box.

Lubrication is provided by generous oil wells from which the oil filters to the bearing through felt pads.

We miss ideal conditions in that it is necessary to fill the oil wells once a week, and adjust for wear every five years.

Do not confuse this construction with soft steel and cast iron, because this bearing positively will not cut.

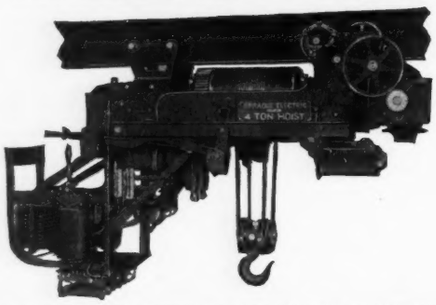
Specify LeBlond Heavy Duty Lathes for your accurate work.

THE R. K. LEBLOND MACHINE TOOL COMPANY

CINCINNATI, OHIO

SPRAGUE ELECTRIC HOISTS

For Lifting and Conveying



S-12 Mono-Rail Crane for Loads of 2 to 6 Tons

ASK FOR PAMPHLET No. 23318
DESCRIBING LABOR-SAVING ELECTRIC HOISTS

This is an overhead transporter operated by electricity direct or alternating.

Runway a commercial I-beam.

Will take curves of ten feet radius.

Will hoist to 33 inches below I-beam.

Track switches may be automatic or hand operated.

Weather proof as shown, but cage may be enclosed to protect operator.

SPRAGUE ELECTRIC COMPANY
527-531 West 34th St., New York City
BRANCH OFFICES IN PRINCIPAL CITIES

One Machine—Twice the Work

Another Landis user says: "We have had one of your 1½" Stay Bolt Cutting Machines in our shop for about two years. It has been satisfactory in every particular and has replaced two machines of another make. It is doing just *twice the work* we succeeded in getting from the other type. We consider your machine the best we have ever had for the purpose."

If you could use a bolt cutter which does twice the work of your present machine, write for details and catalogue.

Landis Machine Co.
Waynesboro, Pa.

The Walter H. Foster Company
50 Church St., N. Y.

Marshall & Huschart Machinery Co., Sole Agents for Chicago and St. Louis. Schuchardt & Schutte, Exclusive Representatives at Berlin, London, Shanghai, Vienna, Stockholm, Tokyo, Budapest, Copenhagen and St. Petersburg. Adler & Eisenschitz, Sole Agents for Italy.

Grant Mfg. & Mch. Co..... 70
Greenfield Machine Co.....102
Heald Mch. Co.....103
Landis Tool Co.....109
LeBlond Mch. Tool Co., R. K., 37-42-43
Modern Tool Co.....174
Morse Twist Drill & Mch. Co.100
Newark Gear Cutting Machine Co.....157
Niles-Bement-Pond Co..68-69-153
Norton Grinding Co.....106
Oesterlein Mch. Co..... 18
Pratt & Whitney Co.....4-5
Ransom Mfg. Co.....111
Rivett Lathe Mfg. Co.....194
Robinson Tool Works.....113
Rockford Drilling Mch. Co..117
Safety Emery Wheel Co.....110
Sellers & Co., Inc., Wm..... 98
Standard Tool Co..... 55
Tabor Mfg. Co.....101
U. S. Electrical Tool Co.... 66
Valley City Mch. Wks.....112
Vandyck Churchill Co.....186
Vitrified Wheel Co.....108
Walker & Co., O. S..Back cover
Wells & Son Co., F. E.....104
Whitney Mfg. Co.....123
Wilmarth & Morman Co....112

Grinding Machines, Plain, Universal
Bath Grinder Co.....108
Brown & Sharpe Mfg. Co.... 71
Greenfield Mch. Co.....102
Hill, Clarke & Co.....80-81
Landis Tool Co.....109
Modern Tool Co.....174
Niles-Bement-Pond Co..68-69-153
Norton Grinding Co.....106
Rivett Lathe Mfg. Co.....194
Thompson Grinder Co..... 81

Grinding or Polishing Machines
American Emery Wheel Wks.110
Barnes Co., W. F. & John.... 33
Bath Grinder Co.....108
Besly & Co., Chas. H.....105
Brown & Sharpe Mfg. Co.... 71
Bryant Chucking Grinder Co.114
Builders' Iron Foundry Back cover
Coates Clipper Mfg. Co.... 90
Diamond Machine Co..Back cover
Gardner Mch. Co.....110
Garvin Machine Co..... 52
Greenfield Machine Co.....102
Harrington, Son & Co., Edwin.127
Heald Machine Co.....103
Landis Tool Co.....109
Newton Mch. Tool Wks., Inc. 61
Niles-Bement-Pond Co..68-69-153
Norton Grinding Co.....106
Ransom Mfg. Co.....111
Rivett Lathe & Mfg. Co.....194
Robinson Tool Works.....113
Roth Bros. & Co.....155
Safety Emery Wheel Co.....110
Sterling Emery Wheel Mfg. Co.....112
U. S. Electrical Tool Co.... 66
Valley City Mch. Wks.....112
Vitrified Wheel Co.....108
Wells & Son Co., F. E.....104

Grinding Wheels
Abrasive Material Co.....104
American Emery Wheel Wks.110
Carborundum Co.....111
Diamond Machine Co..Back cover
Norton Co.....107
Safety Emery Wheel Co.....110
Sterling Emery Wheel Mfg. Co.....112
Vitrified Wheel Co.....108
Whitney Mfg. Co.....123

Gun Barrel Machinery
Diamond Machine Co..Back cover
Pratt & Whitney Co.....4-5
Reed Co., F. E..... 59

Hack Saw Frames
Simonds Mfg. Co..... 39
West Haven Mfg. Co..... 47

Hammers, Air
Nazel Engineering & Mch. Wks..... 59

Hammers, Drop
Billings & Spencer Co..... 70
Bliss Co., E. W.....187
Gould & Eberhardt.....161
Niles-Bement-Pond Co..68-69-153
Waterbury Farrel Fdry & Mch. Co..... 70

Hammers, Pneumatic
Bliss Co., E. W.....187
Dallett Co., Thos. H.....183
Ingersoll-Rand Co.....125
Niles-Bement-Pond Co..68-69-153
Sellers & Co., Inc., Wm..... 98

Hammers, Power
Beaudry & Co.....185
Bradley & Son, C. C.....184
Dienelt & Eisenhardt.....185
Merrill Bros.....181
Nazel Engr. & Mch. Wks.... 39
Scranton & Co.....184
Williams, White & Co.....186

Hammers, Steam
Buffalo Fdry. & Mch. Co.....185
Chambersburg Eng. Co.....185
Erie Fdry. Co.....185
Machinery Forging Co.....113
Massillon Fdry. & Mch. Co..186
Niles-Bement-Pond Co..68-69-153
Ryerson & Son, Jos. T..54A-54B
Sellers & Co., Inc., Wm.... 98
Toledo Mch. & Tool Co.....188
Vandyck Churchill Co.....186
Waterbury Farrel Fdry. & Mch. Co..... 70

Handles, Machine Tool
Cincinnati Ball Crank Co....184

Hangers, Shafting
Brown & Sharpe Mfg. Co.... 71
Sellers & Co., Inc., Wm..... 98

Hardening and Tempering
American Gas Furnace Co....134
Chicago Flexible Shaft Co...132
Coes Wrench Co.....70-120
Rockwell Furnace Co.....133

Hardness Testing Instruments
Shore Instrument & Mfg. Co.154

Heading, Upsetting and Forging Machines
Acme Machinery Co..... 45
Ajax Mfg. Co..... 70
Bliss Co., E. W.....187
Brown Co., H. B.....189
National Mchy. Co..... 63
Niles-Bement-Pond Co..68-69-153
Sellers & Co., Inc., Wm..... 98
Williams, White & Co.....186

Heaters, Feed Water
Stewart Heater Co.....182
Sturtevant Co., B. F..... 38

Heaters, Oil
Rockwell Furnace Co.....133

Heating and Ventilating Apparatus
Sturtevant Co., B. F..... 38

Hobbing Machines, Worm
Adams Co.....161
Brown & Sharpe Mfg. Co.... 71
Lees-Bradner Co.....157
Newark Gear Cutting Machine Co.....157
Newton Mch. Tool Wks., Inc. 61
Pratt & Whitney Co.....4-5
Reynolds Mchy. Co.....128

Hoisting and Conveying Machinery
Caldwell & Son Co., H. W....155
Detroit Hoist & Mch. Co....126
Niles-Bement-Pond Co..68-69-153
Sturtevant Co., B. F..... 38
Yale & Towne Mfg. Co.....129

Hoists, Chain
Harrington, Son & Co., Edwin.127
Niles-Bement-Pond Co..68-69-153
Yale & Towne Mfg. Co.....129

Hoists, Electric
Box & Co., Alfred.....126
Ford Chain Block Co.....124
General Electric Co.....141
Maris Bros.....126
Niles-Bement-Pond Co..68-69-153
Northern Engineering Wks...127
Pawling & Harnischfeger Co.145
Shepard Electric Crane and Hoist Co.....127
Sprague Electric Co..... 44
Toledo-Massillon Bridge Co...127
Westinghouse Electric Co....142
Yale & Towne Mfg. Co.....129

Hoists, Hand
Harrington, Son & Co., Edwin.127
Niles-Bement-Pond Co..68-69-153
Yale & Towne Mfg. Co.....129

Hoists, Pneumatic
Curtis & Co. Mfg. Co.....156
Detroit Hoist & Mch. Co....126
Ingersoll-Rand Co.....125
Northern Engineering Wks...127
Shepard Elec. Crane & Hoist Co.....127
Stow Flexible Shaft Co.....166

Hose
Sprague Electric Co..... 44

Hydraulic Machinery
Chambersburg Engr. Co.....185
Dudgeon, Richard.....171
Niles-Bement-Pond Co..68-69-153
Ryerson & Son, Jos. T..54A-54B
Waterbury Farrel Fdry. & Mch. Co..... 70
Watson-Stillman Co.....128
Williams, White & Co.....186

Hydraulic Tools
Dudgeon, Richard.....171
Niles-Bement-Pond Co..68-69-153
Ryerson & Son, Jos. T..54A-54B
Watson-Stillman Co.....128

Indicators, Speed
Brown & Sharpe Mfg. Co.... 71
Grant Mfg. & Mch. Co..... 70
Greene, Tweed & Co..... 96
Starrett Co., L. S..... 93
Veeder Mfg. Co.....189
Warner Instrument Co.....140

Indicators, Test
Brown & Sharpe Mfg. Co.... 71
Norton Grinding Co.....106
Starrett Co., L. S..... 93

Injectors
Sellers & Co., Inc., Wm..... 98
Walworth Mfg. Co..... 3

Jacks, Hydraulic
Dienelt & Eisenhardt.....185
Dudgeon, Richard.....171
Watson-Stillman Co.....128

Jacks, Planer
Armstrong Bros. Tool Co.121-150

Jacks, Leveling
Binsse Mch. Co..... 11

Key Seaters
Baker Bros.....144
Burr & Sons, John T.....189

Davis Machine Co., W. P.....53
Lapointe Mch. Tool Co.....128
Mitts & Merrill.....28
Morse Twist Drill & Mch. Co.100
Morton Manufacturing Co., Inside front cover
Niles-Bement-Pond Co...68-69-153
Rockford Drilling Mch. Co...117
Ryerson & Son, Jos. T..54A-54B
Whitney Mfg. Co.....123

Keys, Machine
Morton Mfg. Co.Inside front cover
Olney & Warrin.....175
Standard Gauge Steel Co.....97
Whitney Mfg. Co.....123

Knives, Machine
Coes Wrench Co.....70-120
Simonds Mfg. Co.....39

Knurl Holders
Graham Mfg. Co.....192
Pratt & Whitney Co.....4-5

Lamps, Electric
Adams-Bagnall Electric Co...52
Cooper Hewitt Electric Co...151
General Electric Co.....141

Lathe Attachments
American Tool Works Co.....14
Bradford Mch. Tool Co.....9
Diamond Machine Co..Back cover
Fitchburg Machine Works...89
Hendey Mch. Co.....13
LeBlond Mch. Tool Co., R. K., 37-42-43
Niles-Bement-Pond Co...68-69-153
Pratt & Whitney Co.....4-5
Rivett Lathe Mfg. Co.....194
Seneca Falls Mfg. Co.....147-154

Lathe Dogs
Armstrong Bros. Tool Co.121-150
Besly & Co., Chas. H.....105
Billings & Spencer Co.....70
Hammacher, Schlemmer & Co. 77
Pratt & Whitney Co.....4-5
Springfield Mch. Tool Co.....57
Williams & Co., J. H.....86

Lathe and Planer Tools
Armstrong Bros. Tool Co.121-150
LeBlond Mch. Tool Co., R. K., 37-42-43
Le Count, William G.....184
O. K. Tool Holder Co.....189
Pratt & Whitney Co.....4-5
Ready Tool Co.....150
Western Tool & Mfg. Co.....172
Wiley & Russell Mfg. Co.....92
Williams & Co., J. H.....86

Lathes, Automatic Screw Threading
Automatic Machine Co.....154
Fay Machine Tool Co.....118
Pratt & Whitney Co.....4-5

Lathes, Axle
Sellers & Co., Wm.....98
Niles-Bement-Pond Co...68-69-153

Lathes, Bench
Diamond Machine Co..Back cover
Elgin Tool Works.....156
Hardinge Bros.....192
Pratt & Whitney Co.....4-5
Reed Co., F. E.....59
Rivett Lathe Mfg. Co.....194
Seneca Falls Mfg. Co.....147-154
Stark Tool Co.....188
Taylor & Fenn Co.....84
Waltham Watch Tool Co.....96
Wells & Son Co., F. E.....104

Lathes, Boring
Harrington, Son & Co., Edwin.127
Niles-Bement-Pond Co...68-69-153
Sellers & Co., Inc., Wm.....98

Lathes, Brass
Acme Machine Tool Co.....89
Droses Mch. Tool Co.....23
Fay & Scott.....159
Garvin Machine Co.....52
Niles-Bement-Pond Co...68-69-153
Pratt & Whitney Co.....4-5
Springfield Mch. Tool Co.....57
Warner & Swasey Co.....83

Lathes, Chucking
Davis Mch. Co., W. P.....53
International Mch. Tool Co..65
Niles-Bement-Pond Co...68-69-153
Potter & Johnston Mch. Co..60

Lathes, Crank Shaft
LeBlond Mch. Tool Co., R. K. 37-42-43
Lodge & Shipley Mch. Tool Co. 6
Niles-Bement-Pond Co...68-69-153

Lathes, Driving Wheel
Sellers & Co., Wm.....98
Niles-Bement-Pond Co...68-69-153

Lathes, Engine
American Tool Works Co.....14
Barnes Co., W. F. & John.....33
Barnes Drill Co., Inc.....136
Bradford Mch. Tool Co.....9
Champion Tool Works Co.....21
Cincinnati Lathe & Tool Co..122
Davis Machine Co., W. P.....53
Fay & Scott.....159
Flather & Co.....135
Flather Mfg. Co., E. J.....50
Foster Mch. Co.....82
Garvin Machine Co.....52
Greaves, Klusman & Co.....156
Hamilton Machine Tool Co...34
Harrington, Son & Co., Edwin.127
Hendey Mch. Co.....13
Hill, Clarke & Co., Inc....80-81
Le Blond Mch. Tool Co., R. K., 37-42-43
Lodge & Shipley Mch. Tool Co. 6
McCabe, J. J.....24-152
Miami Valley Mch. Tool Co.112
Milwaukee Mch. Tool Co.....89
Morris Mch. Tool Co., Jno. B.180
New Haven Mfg. Co.....135
Niles-Bement-Pond Co...68-69-153
Pratt & Whitney Co.....4-5
Prentice Bros. Co., Inside back cover
Prentiss Tool & Supply Co..56
Rahn-Carpenter Co.....156
Reed Co., F. E.....59
Robbins Mch. Co.....88
Rockford Drilling Mch. Co..117
Rockford Lathe & Drill Co....88
Ryerson & Son, Jos. T..54A-54B
Schumacher & Boye.....18
Sellers & Co., Inc., Wm.....98
Seneca Falls Mfg. Co....147-154
Springfield Mch. Tool Co....57
Vandyck Churchill Co.....186
Von Wyck Mch. Tool Co....37
Walcott & Wood Mch. Tool Co. 98
Whitcomb-Blaisdell Mch. Tool Co. 99

Lathes, Extension
Barnes Drill Co., Inc.....136
Fay & Scott.....159
Harrington, Son & Co., Edwin.127
Niles-Bement-Pond Co...68-69-153

Lathes, Foot Power
Barnes Co., W. F. & John..33
Niles-Bement-Pond Co...68-69-153
Reed Co., F. E.....59
Seneca Falls Mfg. Co.....147-154

Lathes, Gap
Barnes Drill Co., Inc.....136
Fay & Scott.....159
Harrington, Son & Co., Edwin.127
Rahn-Carpenter Co.....156
Sellers & Co., Inc., Wm.....98

Lathes, Hand
Brown & Sharpe Mfg. Co....71

Lathes, Lo-Swing
Fitchburg Mch. Works.....89

Lathes, Pulley
Cincinnati Pulley Mchy. Co.116

Lathes, Speed
Diamond Machine Co..Back cover
Grant Mfg. & Mch. Co.....70
LeBlond Mch. Tool Co., R. K., 37-42-43
Niles-Bement-Pond Co...68-69-153
Reed Co., F. E.....59
Seneca Falls Mfg. Co....147-154
Washburn Shops.....150
Wells & Son Co., F. E.....104
Whitcomb-Blaisdell Mch. Tool Co. 99

Lathes, Turret
Davis Mch. Co., W. P.....53
Fay & Scott.....159
Foster Mch. Co.....82
Gisholt Mch. Co.....97
International Mch. Tool Co..65
Jones & Lamson Mch. Co..16-17
Niles-Bement-Pond Co...68-69-153
Pratt & Whitney Co.....4-5
Reed Co., F. E.....59
Seneca Falls Mfg. Co....147-154
Steinle Turret Mch. Co.....82
Warner & Swasey Co.....83
Windsor Mch. Co.....85

Lathes, Wood
Barnes Co., W. F. & John...33
Fay & Scott.....159
Reed Co., F. E.....59
Seneca Falls Mfg. Co.....147-154

Levels
Keuffel & Esser Co.....151
Starrett Co., L. S.....93

Lockers
Terrell's Equipment Co.....138
Van Dorn Iron Wks. Co....138

Lubricants
Acheson Oildag Co.....65
Besly & Co., Chas. H.....105
Dixon Crucible Co., Jos.....183

Lubricators
Besly & Co., Chas. H.....105
Greene, Tweed & Co.....96

Machinery Dealers
Besly & Co., Chas. H.....105
Garvin Machine Co.....52
Hill, Clarke & Co., Inc.....80 81
Lea Equipment Co.....172
Manning, Maxwell & Moore, Inc. 102
McCabe, J. J.....24-152
Motch & Merryweather Mchy. Co. 152
Niles-Bement-Pond Co...68-69-153
Osgood, J. L.....172
Prentiss Tool & Supply Co...56
Toomey, Inc., Frank.....152
Vandyck Churchill Co.....186

Machinists' Small Tools
Bemis & Call Hardware and Tool Co.....Inside front cover
Besly & Co., Chas. H.....105
Billings & Spencer Co.....70
Boker & Co., Hermann.....131
Boulet's Fine Tool Works....181
Brown & Sharpe Mfg. Co....71
Cleveland Twist Drill Co., 31-70-Back cover
Hammacher, Schlemmer & Co. 77
Le Count, W. G.....184
Millers Falls Co.....Back cover
Morse Twist Drill & Mch. Co.100
Niles-Bement-Pond Co...68-69-153

NOTE THIS RECORD.

EVER SINCE dynamos came into common use, we have been making the Rhoads Dynamo Belt. In all these years, so far as we recall, not one has been returned because of defect—an enviable record.

Many of these belts have been in service for long periods. And the recent ones are as well made or better.

A buyer who purchased one about eighteen months ago, when recently ordering another, said that the first was "a perfect belt."

Let us sell you belts as good, whether for dynamos or other work, both at moderate and high speeds.

The Rhoads Belt costs less per day.

Write for sample of our Record Tag for keeping track of individual belts.

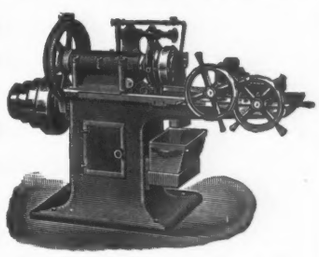
J. E. RHOADS & SONS

PHILADELPHIA: 12 N. Third St.
NEW YORK: 40 Fulton St.
CHICAGO: 243 E. Randolph St.

Factory and Tannery, Wilmington, Del.

BOLT THREADERS, BOLT HEADERS, NUT TAPPERS.

Write us your needs in this line, makers of Bolt and Nut Machinery and Forging Machines of every kind.

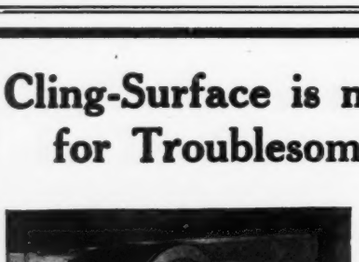


Catalogue on request

THE ACME MACHINERY CO.
CLEVELAND, O., U. S. A.

FOREIGN AGENTS—Schuchardt & Schutte, Berlin, Vienna, Stockholm and St. Petersburg Alfred H. Schutte, Cologne, Paris, Brussels, Liege, Milan and Barcelona. C. W. Burton, Griffiths & Co., London

Cling-Surface is not merely for Troublesome Belts.



Don't consider Cling-Surface merely as a temporary preventive for belt slip. True, it does offer speedy relief in all such cases, but when its use is so restricted you lose two-thirds of the benefits.

Cling-Surface treatment, while keeping belts and ropes themselves preserved, pliable, waterproofed and in best condition always is also most useful in keeping the internal friction load at a constant minimum. A belt treated with Cling-Surface runs uniformly easy or slack, but pulls its full load without other initial tension than produced by the weight of the belt. There is no added strain on the shafting, no journal friction save that consumed in useful work. This means a noticeable saving in power, in lubricants, in bearings and in attention otherwise required, not to mention the lessened dangers of hot boxes.

Give Cling-Surface a trial. If you are not highly pleased, you can have your money back. Write for literature.

Cling-Surface Co

1018 Niagara Street Buffalo N Y

New York Chicago Boston Memphis
St Louis Denver Atlanta Toronto Etc
London Thomas & Bishop 119-125 Finsbury Pavement E C

THE WALTON TAP EXTRACTOR

It is a strong and well built tool. When a tap breaks off, apply the Extractor first, instead of wasting half to three-quarters of an hour each time trying to get hold of the broken piece and back it out with chisels or wires, or perhaps spending still more time annealing the tap and distorting the piece of work, to say nothing of the delay in finishing and shipping the machine.

If you are not taking advantage of the Walton Tap Extractor, it will pay you to investigate.

THE WALTON COMPANY

HARTFORD, CONN.

FOREIGN AGENTS—Schuchardt & Schutte, London, England, Berlin, Vienna, Copenhagen, Stockholm, St. Petersburg. Alfred H. Schutte, Cologne, Milan, Bilbao, Barcelona, Brussels, Liege, Paris. R. S. Stokvis & Zonen, Ltd., Rotterdam, Holland, and the Dutch Colonies.

Pratt & Whitney Co.....4-5
Rogers Wks., Inc., John M..174
Slocomb Co., J. T.....151
Smith, E. G.....173
Standard Tool Co..... 55
Starrett Co., L. S..... 93
Syracuse Twist Drill Co.....182
Walworth Mfg. Co..... 3
Wells Bros. Co..... 92
Whitman & Barnes Mfg. Co..149
Williams & Co., J. H..... 86
Wyke & Co., J.....164

Machinists' Supplies
Bemis & Call Hardware & Tool Co.....Inside front cover
Besly & Co., Chas. H.....105
Hammacher, Schlemmer & Co. 77
McCabe, J. J.....24-152
Osgood, J. L.....172
Whitman & Barnes Mfg. Co..149

Mandrels, Expanding
Morse Twist Drill & Mch. Co 100
Nicholson & Co., W. H.....171
Pratt & Whitney Co.....4-5

Mandrels, Solid
Brown & Sharpe Mfg. Co.... 71
Cleveland Twist Drill Co., 31-70-Back cover
Morse Twist Drill & Mch. Co.100
Pratt & Whitney Co.....4-5
Rogers Wks., Inc., J. M....174
Standard Tool Co..... 55
Western Tool & Mfg. Co....172

Measuring Machines
Pratt & Whitney Co.....4-5
Rogers Wks., Inc., J. M.....174

Mechanical Draft Apparatus
Sturtevant Co., B. F..... 38

Metal
Goldschmidt Thermit Co..... 47
Phosphor Bronze Smelting Co. 40
Reeves & Son, P. S..... 49

Metal Polish
Hoffman, George W.....188

Metals, Bearing
Besly & Co., Chas. H.....105
Lumen Bearing Co.....164
Pratt & Whitney Co.....4-5
Reeves Pulley Co.....149

Meters, Cut
Warner Instrument Co.....140

Micrometer Calipers
Brown & Sharpe Mfg. Co.... 71
Slocomb Co., J. T.....151
Starrett Co., L. S..... 93
Wells Bros. Co..... 92

Milling Attachments
Adams Co.....161
Becker Milling Machine Co.. 78
Brown & Sharpe Mfg. Co.... 71
Cincinnati Milling Mch. Co.. 73
Garvin Machine Co..... 52
Hendey Mch. Co..... 13
Ingersoll Milling Mch. Co.... 22
Kearney & Trecker Co..... 10
Kempsmith Mfg. Co..... 30
LeBlond Mch. Tool Co., R. K. 37-42-43
National Mch. & Tool Wks.. 67
Niles-Bement-Pond Co..68-69-153
Oesterlein Mch. Co..... 18
Owen Machine Tool Co..... 85
Rivett Lathe Mfg. Co.....194
Schneider & Goosmann Mch. Co. 155
Seneca Falls Mfg. Co....147-154
Whitney Mfg. Co.....123

Milling Machines, Bench
Burke Mchy Co..... 50
National Mch. & Tool Wks.. 67
Niles-Bement-Pond Co..68-69-153
Pratt & Whitney Co.....4-5
Rivett Lathe Mfg. Co.....194
Stark Tool Co.....188
Waltham Watch Tool Co.... 96

Milling Machines, Hand
Adams Co.....161
Becker Milling Machine Co... 78
Brown & Sharpe Mfg. Co.... 71
Cincinnati Milling Mch. Co.. 73
Garvin Machine Co..... 52
Pratt & Whitney Co.....4-5
Whitney Mfg. Co.....123

Milling Machines, Horizontal
Adams Co.....161
Beaman & Smith Co.....15-173
Becker Milling Machine Co... 78
Brown & Sharpe Mfg. Co.... 71
Cincinnati Milling Mch. Co.. 73
Hendey Mch. Co..... 13
Ingersoll Milling Mch. Co... 22
Kempsmith Mfg. Co..... 30
Newton Mch Tool Wks., Inc. 61
Niles-Bement-Pond Co...68-69-153
Oesterlein Mch. Co..... 18
Sellers & Co., Inc., Wm..... 98

Milling Machines, Plain
Adams Co.....161
Beaman & Smith Co.....15-173
Becker Milling Mch. Co..... 78
Brown & Sharpe Mfg. Co.... 71
Cincinnati Milling Mch. Co... 73
Fox Mch. Co..... 67
Garvin Machine Co..... 52
Hill, Clarke & Co., Inc.....80-81
Hendey Mch. Co..... 13
Ingersoll Milling Mch. Co.... 22
Kearney & Trecker Co..... 10
Kempsmith Mfg Co..... 30
LeBlond Mch. Tool Co., R. K.. 37-42-43
Morton Mfg. Co.Inside front cover
National Mch. & Tool Wks... 67
Newton Mch. Tool Wks., Inc. 61
Niles-Bement-Pond Co ..68-69-153
Oesterlein Machine Co..... 18
Owen Machine Tool Co..... 85
Pratt & Whitney Co..... 5
Vandyck Churchill Co.....186
Waltham Watch Tool Co.... 96
Warner & Swasey Co..... 83
Whitney Mfg. Co.....123

Milling Machines, Portable
Newton Mch. Tool Wks., Inc.. 61
Niles-Bement-Pond Co...68-69-153
Underwood & Co., H. B.....145

Milling Machines, Universal
American Tool Wks. Co..... 14
Becker Milling Mch. Co..... 78
Brown & Sharpe Mfg. Co.... 71
Cincinnati Milling Mch. Co.. 73
Hendey Mch. Co..... 13
Kearney & Trecker Co..... 10
Kempsmith Mfg. Co..... 30
LeBlond Mch. Tool Co., R. K. 37-42-43
Newton Mch. Tool Wks., Inc. 61
Niles-Bement-Pond Co...68-69-153
Oesterlein Mch. Co..... 18
Owen Machine Tool Co..... 85
Waltham Watch Tool Co..... 96

Milling Machines, Vertical
Adams Co.....161
Beaman & Smith Co.....15-173
Becker Milling Machine Co.. 78
Brown & Sharpe Mfg. Co.... 71
Cincinnati Milling Mch. Co... 73
Hill, Clarke & Co., Inc.....80-81
Ingersoll Milling Mch. Co.... 22
Newton Mch. Tool Wks., Inc.. 61
Niles-Bement-Pond Co..68-69-153
Owen Machine Tool Co..... 85
Sellers & Co., Inc., Wm..... 98
Vandyck Churchill Co.....186
Waltham Watch Tool Co.... 96

Milling Machines, Worm
Cleveland Auto. Mch. Co.... 62
Pratt & Whitney Co.....4-5

Milling Tools (Hollow Adjustable)
Geometric Tool Co.....113
Rogers Works, Inc., J M....174

Mining Machinery
Ingersoll-Rand Co.....125

Molding Machines
Adams Co.....161
Tabor Mfg. Co.....101

Motors, Electric
Coates Clipper Mfg. Co..... 90
Crocker-Wheeler Co.....143
Eck Dynamo & Motor Co....140
Fort Wayne Elec. Works....142
General Electric Co.....141
Reliance Elec. & Eng. Co....140
Roth Bros. & Co.....155
Sprague Electric Co..... 44
Sturtevant Co., B. F..... 38
Wagner Elec. Mfg Co.....142
Westinghouse Elec. & Mfg. Co. 142

Nipple Threading Machinery
Bignall & Keeler Mfg. Co....191
Landis Mch. Co., Inc..... 44
Loew Mfg. Co.....189
Merrell Mfg Co.....190
Mummert, Wolf & Dixon Co..188
Saunders' Sons, D.....190
Standard Engineering Co....191

Nozzles
McCullough-Dalzell Crucible Co. 194

Nut Tappers
See Bolt and Nut Machinery.

Odometers
Veeder Mfg. Co.....189

Oil Cans
Delphos Mfg. Co.....159

Oil Cups
Bay State Stamping Co.....182
Besly & Co., Chas. H.....105
Tucker, W. M & C. F..... 40

Oil Hole Covers
Bay State Stamping Co.....182
Tucker, W. M. & C. F..... 40

Oils
Besly & Co., Chas. H.....105

Oilers
Bay State Stamping Co.....182
Osgood, J. L.....172

Oil Separating Machines
Oil and Waste Saving Mch. Co. 152

Packing
New York Belting and Packing Co..... 94

Pans, Lathe
New Britain Mch. Co.....173

Pans, Shop
New Britain Mch. Co.....173

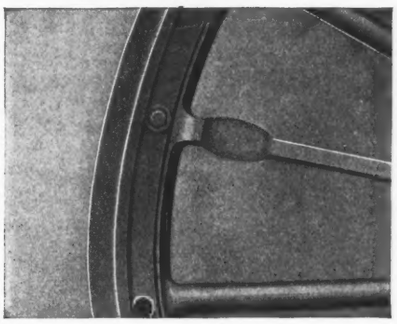
Pattern Letters
Butler, A. G.....164

Pattern Shop Tools and Machinery
Baker Bros.....144
Fox Machine Co..... 67
Greaves, Klusman & Co.....156
Hammacher, Schlemmer & Co. 77
Niles-Bement-Pond Co...68-69-153
Seneca Falls Mfg Co....147-154
Whitcomb Blaisdell Mch. Tool Co. 99

Phosphor Bronze
Lumen Bearing Co.....164
Phosphorizers
McCullough-Dalzell Crucible Co. 194
Pinion Cutters
Stark Tool Co.....188
Pipe Cutting and Threading Machines
Armstrong Mfg. Co.....190
Bignall & Keeler Mfg. Co....191
Curtis & Curtis Co.....190
Hart Mfg. Co..... 49
Landis Machine Co., Inc.... 44
Loew Mfg. Co.....189
Merrell Mfg. Co.....190
Niles-Bement-Pond Co ..68-69-153
Pratt & Whitney Co.....4-5
Saunders' Sons, D.....190
Standard Engineering Co....191
Stoever Fdry. & Mfg. Co....188
Trimont Mfg. Co.....191
Walworth Mfg. Co..... 3
Wells Bros. Co..... 92
Wells & Son Co., F. E.....104
Wiley & Russell Mfg. Co.... 92
Pipe Fitters' Tools
Butterfield & Co..... 39
Cleveland Twist Drill Co., 31-70-Back cover
Pratt & Whitney Co.....4-5
Reed Mfg. Co.....180
Saunders' Sons, D.....190
Standard Tool Co..... 55
Stoever Fdry. & Mfg. Co....188
Trimont Mfg. Co.....191
Walworth Mfg. Co..... 3
Wells Bros. Co..... 92
Wells & Son Co., F. E.....104
Williams & Co., J. H..... 86
Pipes and Fittings
National Tube Co.....164
Walworth Mfg. Co..... 3
Planer Attachments
Cincinnati Planer Co..... 19
Gray Co., G. A..... 32
Niles-Bement Pond Co...68-69-153
Reed Co., F. E..... 59
Planer Tools
Armstrong Bros. Tool Co.121-150
Planers
American Tool Works Co.... 14
Betts Mch. Co..... 7
Cincinnati Planer Co..... 19
Cleveland Planer Works.....137
Detrick & Harvey Mch. Co...145
Fitchburg Machine Works... 89
Flather Planer Co., Mark....144
Gleason Works, Front cover-Back cover
Gray Co., G. A..... 32
Hamilton Machine Tool Co.. 34
Harrington, Son & Co., Edwin.127
Hendey Machine Co..... 13
Knecht Planer Co..... 70
Morton Mfg. Co.Inside front cover
New Haven Mfg. Co.....135
Newton Mch. Tool Wks., Inc. 61
Niles-Bement-Pond Co..68-69-153
Ohio Mch. Tool Co..... 88
Pratt & Whitney Co.....4-5
Rockford Mch. Tool Co.....119
Schneider & Goosmann Mch. Co. 155
Sellers & Co., Inc., Wm..... 98
Whitcomb-Blaisdell Mch. Tool Co 99
Wilson, W. A., Mch. Co.... 70
Woodward & Powell Planer Co. 3
Planers, Parallel
Walker & Co., O. S...Back cover
Planers, Portable
Morton Mfg. Co.Inside front cover
Newton Mch Tool Wks., Inc. 61
Niles-Bement-Pond Co..68-69-153
Underwood Co., H. B.....145
Planers, Rotary
Newton Mch. Tool Wks., Inc. 61
Niles-Bement-Pond Co..68-69-153
Sellers & Co., Inc., Wm..... 98
Underwood Co., H. B.....145
Plate Rolls
Niles-Bement-Pond Co..68-69-153
Taylor-Wilson Mfg. Co., Inside front cover
Plumbago Goods
McCullough-Dalzell Crucible Co. 194
Pneumatic and Turntable Motors
Detroit Hoist & Mch. Co....126
Pneumatic Tools
Bliss Co., E. W.....187
Ingersoll-Rand Co.....125
Manning, Maxwell & Moore, Inc. 102
Shepard Elec. Crane & Hoist Co. 127
Portable Tools, Repair, Railroad, etc.
Underwood & Co., H. B....145
Precision Machinery
Pratt & Whitney Co.....4-5
Rivett Lathe Mfg. Co.....194
Stark Tool Co.....188
Waltham Watch Tool Co.... 96
Presses, Arch
Bliss Co., E. W.....187
Waterbury Farrel Fdry. & Mch. Co..... 70
Presses, Broaching
Bliss Co., E. W.....187
Swaine Mfg. Co., F. J.....187
Watson-Stillman Co.....128
Presses, Drop
Bliss Co., E. W.....187
Miner & Peck Mfg. Co. Back cover
Niles-Bement-Pond Co...68-69-153
Waterbury Farrel Fdry. & Mch. Co..... 70
Presses, Foot and Hand
Bliss Co., E. W.....187
Ferracute Mch. Co.....166
Taylor & Fenn Co..... 84
Presses, Forging
Bliss Co., E. W.....187
Niles-Bement-Pond Co...68-69-153
Swaine Mfg. Co., F. J.....187
Toledo Mch. & Tool Co.....188
Waterbury Farrel Fdry. & Mch. Co..... 70
Presses, Hydraulic
Niles-Bement-Pond Co...68-69-153
Sellers & Co., Inc., Wm..... 98
Waterbury Farrel Fdry. & Mch. Co..... 70
Watson-Stillman Co.....128
Presses, Power
Ams Mch. Co., Max.....166
Automatic Machine Co.....154
Billings & Spencer Co..... 70
Bliss Co., E. W.....187
Dill Mch. Co., T. C.....122
Ferracute Machine Co.....166
Niles-Bement-Pond Co...68-69-153
Springfield Machine Tool Co.. 57
Swaine Mfg. Co., F. J.....187
Toledo Mch. & Tool Co.....188
Vandyck Churchill Co.....186
Waterbury Farrel Fdry. & Mch. Co..... 70
Presses, Power Forcing
Barnes Co., W. F. & John.... 33
Lucas Machine Tool Co.... 75
Presses, Screw
Barnes Co., W. F. & John.... 33
Bliss Co., E. W.....187
Waterbury Farrel Fdry. & Mch. Co..... 70
Professional
Burnham, Royal E.....154
Howson & Howson.....154
Macdonald & Macdonald.....154
Owen, R. B.....154
Parker, C. L.....154
Prescott, Sydney I.....154
Stevens & Co., Milo B.....154
Whittlesey, Geo. P.....154
Profilers
Becker Milling Machine Co.. 78
Garvin Machine Co..... 52
Newton Mch. Tool Wks., Inc. 61
Pratt & Whitney Co.....4-5
Stark Tool Co.....188
Pulley Blocks
Yale & Towne Mfg. Co.....129
Pulleys
American Pulley Co.....124
Brown & Sharpe Mfg. Co.... 71
Caldwell & Son Co., H. W....155
New Haven Mfg. Co.....135
Philips Pressed Steel Pulley Works 129
Poole Engr. & Mch. Co.....182
Reeves Pulley Co.....149
Saginaw Mfg. Co.....181
Sellers & Co., Inc., Wm..... 98
Taylor-Wilson Mfg. Co., Inside front cover
Wilmarth & Morman Co....112
Wood's Sons Co., T. B..... 51
Pulley Turning and Boring Machines
American Tool Wks. Co..... 14
Harrington Son & Co., Edwin.127
New Haven Mfg. Co.....135
Newton Mch. Tool Wks., Inc. 61
Niles-Bement-Pond Co...68-69-153
Pumps, Electric
General Electric Co.....141
Pumps, Hydraulic
General Electric Co.....141
Watson-Stillman Co.....128
Pumps, Pneumatic
Ingersoll-Rand Co.....125
Pumps, Steam
Ingersoll-Rand Co.....125
Leiman Bros.....146
Waterbury Farrel Fdry. & Mch. Co..... 70
Punches, Centering
Brown & Sharpe Mfg. Co.... 71
Hammacher, Schlemmer & Co 77
Sellers Co., Inc., Wm..... 98
Starrett Co., L. S..... 93
Punches and Dies
Armstrong-Blum Mfg. Co....181
Bliss Co., E. W.....187
Burke Mchy. Co..... 50
Globe Mch. & Stamping Co... 51
Pratt & Whitney Co.....4-5
Richards Co., I. P.....184
Swaine Mfg. Co., F. J.....187
Watson-Stillman Co.....128
Whitman & Barnes Mfg. Co..149
Punches, Hydraulic
Niles-Bement-Pond Co..68-69-153
Sellers & Co., Inc., Wm..... 98
Watson-Stillman Co.....128

For Repairs on Wrought Iron or Steel Sections use the

Thermit Welding Process



Broken spoke in locomotive wheel, welded by Thermit process

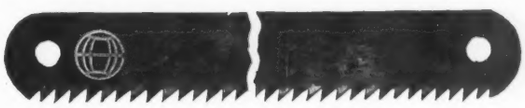
It enables heavy sections to be repaired without removing them from their position. Locomotive frames, Sternposts of steamships, Crank shafts, etc., may be repaired more quickly and at less expense than by any other method.

Small sections and pieces not exceeding 5000 lbs. in weight will be promptly repaired if sent to any of our shops.

Write for Pamphlet No. 20-A which gives full particulars.

GOLDSCHMIDT THERMIT COMPANY
90 West St., New York City
432-436 Folsom Street, San Francisco
103 Richmond Street, W. Toronto, Can.

Every Tooth Cuts



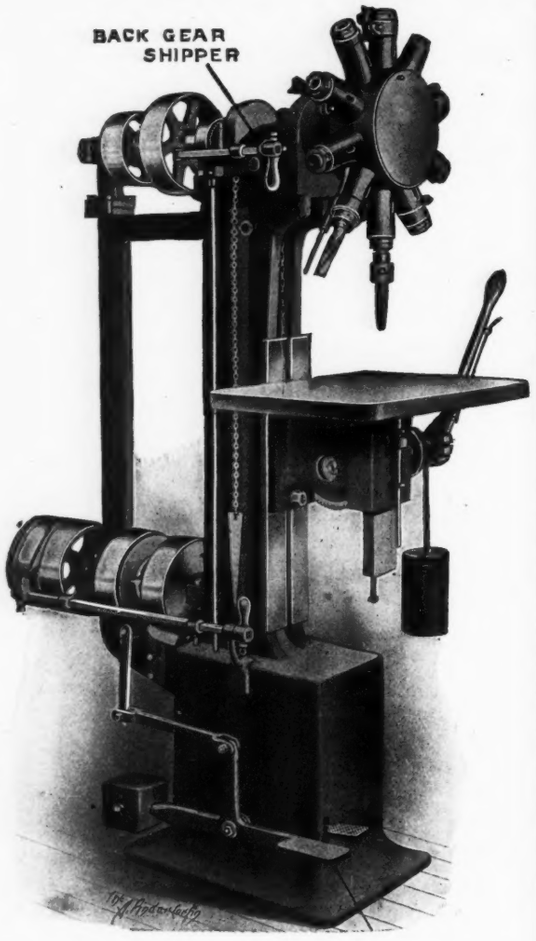
Universal Hack Saw Blades

Are made of the finest steel and tempered by an improved process which insures uniform cutting qualities from tip to tip.

Teeth are set exactly enough to give a free, smooth, rapid cut without removing an unnecessary amount of stock.

"Universal" hand or power blades for every class of work. Let us send samples—test them yourself. We abide by results—"Universal" Hack Saw results.

WEST HAVEN MFG. CO.
NEW HAVEN, CONN.



SWING TOOLS INTO LINE

Quint's No. 2 Improved Turret Drill

With its battery of tools for drilling, boring, tapping, etc. will put your shop on a new level of economical production.

Any one of the tools is instantly brought into use without stopping the machine. They center automatically and complete from four to twelve different operations at one setting of the work.

A very important advantage for large or irregular pieces, jig work, etc. is that the tool, not the work, rotates, a feature which distinguishes the Quint from all other turret machines. Heavy back gears, ratchet lever feed, reverse motion for tapping and counterbalanced table. All taps and dies fastened directly to the spindle and only the spindle in use rotates. Nicely adapted for finishing all tapped holes in **Automobile Cylinders** at one setting of piece.

Write for specifications and catalogue.

A. E. QUINT, Hartford, Conn.

FOREIGN AGENTS: Ph. Bonvillain and E. Ronceray, Paris, France. C. W. Burton, Griffiths & Co., London, England. Haelbig, Wagner & Co., Dresden, Germany. Schuchardt & Schutte, Vienna, Austria.

Punches, Power
Armstrong-Blum Mfg. Co....181
Bliss Co., E. W.....187
Ferracute Mch. Co.....166
Long & Allstatter Co.....186
Mitts & Merrill..... 28
Niles-Bement-Pond Co...68-69-153
Royersford Fdry. & Mch. Co., 101-164
Sellers & Co., Inc., Wm..... 98

Punching and Shearing Machinery
Bliss Co., E. W.....187
Cincinnati Punch & Shear Co.184
Erie Foundry Co.....185
Long & Allstatter Co.....186
Niles-Bement-Pond Co...68-69-153
Pratt & Whitney Co.....4-5
Royersford Fdry. & Mch. Co., 101-164
Ryerson & Son, Jos. T..54A-54B
Sellers & Co., Inc., Wm..... 98
Toledo Mch. & Tool Co.....188
Waterbury-Farrel Fdry. & Mch. Co. 70
Watson-Stillman Co.....128
Williams, White & Co.....186

Rack Cutting Machines
Adams Co.....161
Fellows Gear Shaper Co.... 32
Flather Mfg. Co., E. J..... 50
Gould & Eberhardt.....161
Horsburgh & Scott Co.....160
LeBlond Mch. Tool Co., R. K.. 37-42-43
Niles-Bement-Pond Co...68-69-153
Reed Co., F. E..... 59
Walcott & Wood Mch. Tool Co. 98

Racks, Cut
Boston Gear Works.....159
Brown & Sharpe Mfg. Co.... 71
Fellows Gear Shaper Co.... 32
Flather Mfg. Co., E. J..... 50
Horsburgh & Scott Co.....160
LeBlond Mch. Tool Co., R. K.. 37-42-43
Newark Gear Cutting Mch. Co. 157
Nuttall Co., R. D.....160
Philadelphia Gear Works, Inc.159
Standard Gauge Steel Co.... 97
Taylor-Wilson Mfg. Co., Inside front cover
Walcott & Wood Mch. Tool Co. 98

Racks, Tool
New Britain Mch. Co.....173
Terrell's Equipment Co.....138
Van Dorn Iron Works Co....138
Western Tool & Mfg. Co....172

Radiators, Japanning Oven
American Gas Furnace Co...134
Rockwell Furnace Co.....133
Steiner, E. E.....184

Rapping Plates
Milwaukee Fdry. Supply Co..113

Reamers
Boker & Co., Hermann.....131
Brown & Sharpe Mfg. Co.... 71
Butterfield & Co..... 39
Card Mfg. Co., S. W.....115
Carpenter Tap & Die Co., J. M., 165-Back cover
Cleveland Twist Drill Co., 31-70-Back cover
Gisholt Mch. Co..... 97
Kelly Reamer Co.....126
Lapointe Mch. Tool Co.....128
McCrosky Reamer Co.....151
Morse Twist Drill & Mch. Co.100
Pratt & Whitney Co.....4-5
Rogers Works, Inc., John M..174
Standard Tool Co..... 55
Van Dorn & Dutton Co..143-160
Walworth Mfg. Co..... 3
Ward & Sons, Edgar T.....161
Wells Bros. Co..... 92
Whitman & Barnes Mfg. Co...149
Wiley & Russell Mfg. Co..... 92

Reamers, Adjustable
Cleveland Twist Drill Co., 31-70-Back cover
Kelly Reamer Co.....126
Lapointe Mch. Tool Co.....128
McCrosky Reamer Co.....151
Morse Twist Drill & Mch. Co.100
Pratt & Whitney Co.....4-5
Rogers Works, Inc., John M..174
Schellenbach-Hunt Tool Co..147

Reamers, Electric
Van Dorn & Dutton Co..143-160

Reamers, Pneumatic
Stow Flexible Shaft Co.....166

Reaming Stands
Flather Planer Co., Mark....144
Skinner Chuck Co.....178

Recorders, Speed
Warner Instrument Co.....140

Rheostats
General Electric Co.....141
Westinghouse Elec. & Mfg. Co.142

Rivet and Spike Machinery
National Mchy. Co..... 63

Riveters, Hydraulic
Niles-Bement-Pond Co...68-69-153
Sellers & Co., Inc., Wm..... 98

Riveters, Pneumatic
Bliss Co., E. W.....187
Dallett Co., Thos. H.....183
Ingersoll-Rand Co.....125
Niles-Bement-Pond Co...68-69-153
Sellers & Co., Inc., Wm..... 98
Shepard Electric Crane & Hoist Co.....127
Waterbury Farrel Fdry. & Mch. Co..... 70

Riveters, Steam
Niles-Bement-Pond Co...68-69-153
Sellers & Co., Inc., Wm..... 98

Riveting Machines
Chambersburg Eng. Co.....185
Cincinnati Pulley Mchy. Co..116
Grant Mfg. & Mch. Co..... 70
Long & Allstatter Co.....186
National Machinery Co..... 63
Niles-Bement-Pond Co...68-69-153
Sellers & Co., Inc., Wm..... 98

Rope Dressing and Preservative
Cling-Surface Co..... 46

Rules, Steel
Brown & Sharpe Mfg. Co.... 71
Dill Mch. Co., T. C.....122
Hammacher, Schlemmer & Co. 77
Keuffel & Esser Co.....151
Kolesch & Co.....159
Lufkin Rule Co..... 51
Slocomb Co., J. T.....151
Starrett Co., L. S..... 93

Saw Blades
Atkins & Co., Inc., E. C.....172
Boker & Co., Hermann.....131
Diamond Saw & Stamping Wks. 40
Hammacher, Schlemmer & Co. 77
Millers Falls Co.....Back cover
Simonds Mfg. Co..... 39
West Haven Mfg. Co..... 47

Saw Frames and Blades, Hack
Hammacher, Schlemmer & Co. 77
Millers Falls Co.....Back cover
Niles-Bement-Pond Co...68-69-153
Simonds Mfg. Co..... 39
Starrett Co., L. S..... 93
West Haven Mfg. Co..... 47

Sawing Machines, Metal
Gorton Machine Co., George..173
Hoefer Mfg. Co.....137
Lea Equipment Co.....172
Newton Mch. Tool Wks. Inc.. 61
Niles-Bement-Pond Co...68-69-153
Ryerson & Son, Jos. T..54A-54B
Tabor Mfg. Co.....101
Union Twist Drill Co..... 29
Vandyck Churchill Co.....186
West Haven Mfg. Co..... 47

Sawing Machines, Wood
Fox Mch. Co..... 67
Greaves, Klusman & Co.....156
Seneca Falls Mfg. Co....147-154

Saws, Friction
Ryerson & Son, Jos. T..54A-54B

Saws, Metal Band
Crescent Mch. Co.....188
Huther Bros. Saw Mfg. Co..188
Niles-Bement-Pond Co..68-69-153
West Haven Mfg. Co..... 47

Saws, Power Hack
Armstrong-Blue Mfg. Co.....181
Atkins & Co., Inc., E. C.....172
Billings & Spencer Co..... 70
Buffalo Specialty Co.....173
Diamond Saw & Stamping Wks. 40
Espen-Lucas Mch. Wks.....181
Hoefer Mfg. Co.....137
Millers Falls Co.....Back cover
Niles-Bement-Pond Co..68-69-153
Racine Tool & Mch. Co.....172
Story, H. T.....181
Tabor Mfg. Co.....101
West Haven Mfg. Co..... 47

Saws, Screw Slotting
Pratt & Whitney Co.....4-5
Simonds Mfg. Co..... 39

Saw Sharpening Machines
Newton Mch. Tool Wks., Inc.. 61

Saw Tables
Crescent Mch. Co.....188
Seneca Falls Mfg. Co....147-154

Schools
International Corr. School... 91
Pratt Institute.....150

Screw Cutting Tools
Brubaker & Bros., W. L.....188
Butterfield & Co..... 39
Card Mfg. Co., S. W.....115
Carpenter Tap & Die Co., J. M.....165
Reece Co., E. F.....165
Smart Mfg. Co., A. J. Back cover
Walworth Mfg. Co..... 3
Wells Bros. Co..... 92

Screw Driver, Automatic
Reynolds Mchy Co.....128

Screw Machines, Automatic
Acme Mch. Tool Co..... 89
Brown & Sharpe Mfg. Co..... 71
Cleveland Automatic Mch. Co. 62
Dreses Mch. Tool Co..... 23
Foster Mch. Co..... 82
Garvin Mch. Co..... 52
Milled Screw & Mch. Co.....147
National-Acme Mfg. Co.....193
Pratt & Whitney Co.....4-5
Prentice Co., Inc., Geo. G.... 52
Universal Mch. Screw Co.... 96
Warner & Swasey Co..... 83
Windsor Mch. Co..... 85

Screw Machines, Hand
Acme Machine Tool Co..... 89
Brown & Sharpe Mfg. Co.... 71
Cleveland Automatic Mch. Co. 62
Foster Machine Co..... 82
Garvin Machine Co..... 52
Grant Mfg. & Mch. Co..... 70
Jones & Lamson Mch. Co..16-17
Potter & Johnston Mch. Co... 60
Pratt & Whitney Co..... 4-5
Rivett Lathe Mfg. Co.....194
Seneca Falls Mfg. Co....147-154
Wells & Son Co., F. E.....104
Warner & Swasey Co..... 83
Whitcomb-Blaisdell Mch. Tool Co. 99
Windsor Mch. Co..... 85

Screw Machine Work
Milled Screw & Mch. Co.....147
National-Acme Mfg. Co.....193
Universal Mch. Screw Co.... 96

Screw Machinery, Wood and Lag
Baker Bros. 144
Cook Co., Asa S..... 173

Screw Plates
Besly & Co., Chas. H.....105
Butterfield & Co..... 39
Card Mfg. Co., S. W.....115
Carpenter Tap & Die Co., J. M.....165-Back cover
Morse Twist Drill & Mch. Co..100
Wells Bros. Co..... 92
Wiley & Russell Mfg. Co.... 92

Screws, Cap and Set
Electric Welding Products Co.139
Hammacher, Schlemmer & Co. 77
National-Acme Mfg. Co.....193

Screws, Machine
Electric Welding Products Co.139
Hammacher, Schlemmer & Co. 77
National-Acme Mfg. Co.....193
Standard Gauge Steel Co.... 97

Second Hand Machinery
Davis Machine Co., W. P.... 53
Hill, Clarke & Co., Inc....80-81
McCabe, J. J.....24-152
McCabe Machine Co.....152
Motch & Merryweather Mchy. Co. 152
Niles-Bement-Pond Co..68-69-153
Prentiss Tool & Supply Co.. 56
Toomey, Inc., Frank.....152

Separators, Oil and Steam
Nicholson & Co., W. H.....171

Shaft Hangers
Wood's Sons Co., T. B..... 54

Shaft Leveling Device
Kinkead Mfg. Co..... 54

Shapers
American Tool Works Co.... 14
Cincinnati Shaper Co..... 20
Davis Machine Co., W. P.... 53
Fitchburg Machine Works.... 89
Flather Planer Co., Mark....144
Fox Mch. Co..... 67
Gould & Eberhardt.....161
Hamilton Mch. Tool Co..... 34
Hendey Machine Co..... 13
Hill, Clarke & Co., Inc.....80-81
Kelly Co., R. A.....144
Lutter & Gies Co.....112
Morton Mfg. Co.Inside front cover
Newark Gear Cutting Mch. Co.157
New Haven Mfg. Co.....135
Newton Mch. Tool Wks. Inc.. 61
Niles-Bement-Pond Co..68-69-153
Ohio Mch. Tool Co..... 88
Potter & Johnston Mch. Co... 60
Prentiss Tool & Supply Co.. 56
Rhodes, L. E..... 86
Rockford Mch. Tool Co.....119
Sellers & Co., Inc., Wm..... 98
Smith & Mills Co.....150
Springfield Mch. Tool Co.... 57
Steptoe Shaper Co., John....150
Stockbridge Mch. Co..... 30
Walcott & Wood Mch. Tool Co. 98

Shears, Power
Bliss Co., E. W.....187
Ferracute Mch. Co.....166
Long & Allstatter Co.....186
Mitts & Merrill..... 28
Niles-Bement-Pond Co..68-69-153
Roycrsford Fdry. & Mch. Co. 101-164
Sellers & Co., Inc., Wm..... 98
Whitcomb-Blaisdell Mch. Tool Co. 99

Shears, Rotary
Bliss Co., E. W.....187
Detrick & Harvey Mch. Co....145

Sheet Metal Working Machinery
Bliss Co., E. W 187
Ferracute Machine Co.....166
Swaine Mfg. Co., F. J.....187

Slide Rests
Betts Mch. Co..... 7
National-Acme Mfg. Co.....193
Newton Mch. Tool Wks., Inc.. 61
Niles-Bement-Pond Co..68-69-153
Reed Co., F. E..... 59

Slotters, Machine
Baker Bros.....144
Betts Mch. Co..... 7
Dill Mch. Co., T. C.....122
New Haven Mfg. Co.....135
Newton Mch. Tool Wks., Inc.. 61
Niles-Bement-Pond Co..68-69-153
Sellers & Co., Inc., Wm..... 98

Slotters, Portable
Newton Mch. Tool Wks., Inc.. 61

Sockets and Sleeves
Cleveland Twist Drill Co., 31-70-Back cover
Morse Twist Drill & Mch. Co..100
Standard Tool Co..... 55
Union Twist Drill Co..... 29

Special Machinery and Tools
Automatic Mch. Co.....154
Beaman & Smith Co.....15-173
Bilgram Machine Wks.....158
Blanchard Machine Co..... 52
Bliss Co., E. W.....187
Buffalo Fdry. & Mch. Co.....185
Dallett Co., Thos. H.....183
Earle Gear & Machine Co....158
Electric Welding Products Co.139
Foster Machine Co..... 82
Garvin Mch. Co..... 52
Hoefer Mfg. Co.....137
Hoggson & Pettis Mfg. Co....175
Horton Machine Co., S. E....174
Lucas Machine Tool Co..... 75
Modern Tool Co.....174
Morrow Mfg. Co.....174
Mueller Mch. Tool Co..... 83
National Mchy. Co..... 63
Nazel Eng. & Mch. Wks.....39
Niles-Bement-Pond Co..68-69-153
Owen Machine Tool Co..... 85
Pratt & Whitney Co.....4-5
Spacke Mch. Co., W. F.....156
Standard Engineering Co....191
Taylor & Fenn Co..... 84
Taylor-Wilson Co., Inside front cover

Speed Changing Devices
Evans, G. F.....184
Reeves Pulley Co.....149

Springs
American Vanadium Co..... 27

Sprocket Chains
Bilgram Machine Works.....158
Boston Gear Works.....159
Brown & Sharpe Mfg. Co.... 71
Philadelphia Gear Wks. Inc..159

Stampings, Sheet Metal
Bay State Stamping Co.....182

Stamps, Letters and Figures
Noble & Westbrook.....164
Schwerdtle Stamp Co.....175

Stamps, Steel
Hoggson & Pettis Mfg. Co....175
Noble & Westbrook.....164
Schwerdtle Stamp Co.....175

Steel
Baker & Co., Hermann.....131
Cammell Laird & Co..... 84
Columbia Steel Co.....164
Firth-Sterling Steel Co..... 58
Hawkridge Bros. Co.....165
Heller Bros. Co..... 52
Jessop & Sons, Ltd., Wm.... 49
Ward & Sons, Edgar T.....164

Steel Castings and Forgings
Hay-Budden Mfg. Co..... 49
Jessop & Sons, Ltd., Wm..... 49

Steel, Machinery
Baker & Co., Hermann.....131
Cammell Laird & Co..... 84
Columbia Steel Co.....164
Firth-Sterling Steel Co..... 58
Hawkridge Bros. Co.....165
Standard Gauge Steel Co.... 97
Jessop & Sons, Ltd., Wm.... 49
Ward & Sons, Edgar T.....164

Steel Shelving, Racks, Barrels, Tables, etc.
Terrell's Equipment Co.....138
Van Dorn Iron Wks. Co.....138

Steel, Tool
Baker & Co., Hermann.....131
Cammell Laird & Co..... 84
Columbia Steel Co.....164
Firth-Sterling Steel Co..... 58
Hawkridge Bros. Co.....165
Heller Bros. Co..... 52
Jessop & Sons, Ltd., Wm.... 49
Standard Gauge Steel Co.... 97
Ward & Sons, Edgar T.....164

Steel, Vanadium
American Vanadium Co..... 27

Stocks, Die
See Taps and Dies.

Stones, Oil
American Emery Wheel Wks..110
Carborundum Co.....111
Norton Co.....107
Vitrified Wheel Co.....108

Stoppers
McCullough-Dalzell Crucible Co. 194

Straightening Machinery
Morse Twist Drill & Mch. Co.100
Niles-Bement-Pond Co..68-69-153
Sellers & Co., Inc., Wm..... 98
Springfield Machine Tool Co. 57

Straighteners, Hydraulic
Niles-Bement-Pond Co..68-69- 53

Something to Notice

Instead of being able to use the dies (four to a set for each diameter) for our tools for just the diameter marked on them, a user can thread

"Duplex" Die Stocks

two or three besides, because of their wide adjustability, thus covering several over sizes and a little under size.

MANUFACTURED BY

The Hart Manufacturing Company

10 Wood Street, CLEVELAND, OHIO, U. S. A.

DIE FORGINGS

WELDLESS RINGS
STEEL FORGINGS

10 per cent. to 25 per cent. more blanks can be cut by dies finished from our Forgings. Our steel is made especially for us and we forge by a process that is all our own.

HAY-BUDDEN MFG. COMPANY

254 No. Henry St. BROOKLYN, N. Y.

Bronze Castings, Babbitt Metals,

"Tubal" Bronze, 75,000 lbs. ultimate strength per square inch. Propellers. Phosphor Bronze, Rolled. Phosphor Bronze Castings.

Our 40 years' experience is worth something to you.

PAUL S. REEVES & SON

1415 Catharine Street, PHILADELPHIA, PA.

Jessop's Best Carbon Tool Steel

is yet unexcelled for cutting tools of all kinds and for general machine shop use.

Jessop's "Ark" High Speed Air Hardening Steel

gives marvelous results—heavy cuts—at rapid speed; cannot be burned.

Manufactured in Sheffield, England

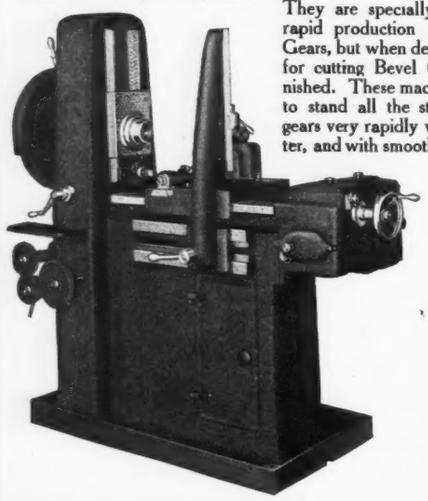
WM. JESSOP & SONS, Inc., 91 John St., NEW YORK

20 Highest Exhibition Awards

FLATHER AUTOMATIC GEAR CUTTING MACHINES

1910 DESIGN

are equipped with an original and simple **FEED CHANGE MECHANISM**, enabling the operator to obtain a variety of feeds **without change of gears.**



They are specially designed for the rapid production of accurate Spur Gears, but when desired an attachment for cutting Bevel Gears can be furnished. These machines are fully able to stand all the strains of producing gears very rapidly without jar or chatter, and with smooth teeth of the greatest accuracy from the finest to the coarsest pitch.

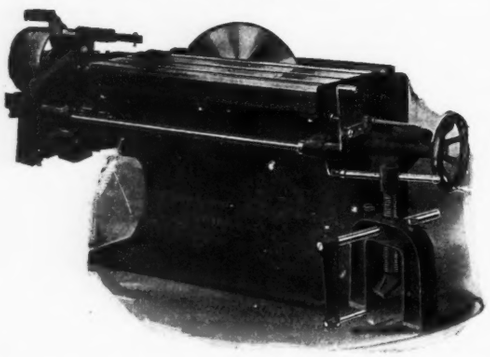
They are simple, easy to understand, easy to operate, and they have innumerable important, exclusive features that will appeal to you at once.

Let us fully inform you NOW—write for our descriptive circulars.

E. J. FLATHER MFG. COMPANY
NASHUA, N. H., U. S. A.

Rigidity of Blade and Steady Drive

are advantages of the



Burke 20" Cutting-off Saw

that count largely in the accuracy of work produced. Solid steel or tubing can be cut with the same blade. The elimination of back-lash reduces the breakage of saws to the minimum. Automatic knockout and large clamping table are further good points.

Two sizes, 12" and 20". Write for circular.

The Burke Machinery Co.
CONNEAUT, OHIO, U. S. A.

Sub-Press Dies
Waltham Mch. Wks.....159
Swaging Machines
Excelsior Needle Co.....187
Switchboards
General Electric Co.....141
Westinghouse Elec. & Mfg. Co.142
Switches
General Electric Co.....141
Westinghouse Elec. & Mfg. Co.142
Tachometers
Veeder Mfg. Co.....189
Tapes, Measuring
Keuffel & Esser Co.....151
Lufkin Rule Co..... 51
Starrett Co., L. S..... 93
Tap Extractors, Broken
Walton Co..... 46
Tap Holders
Brown & Sharpe Mfg. Co.... 71
Tapping Machines and Attachments
American Tool Works Co.... 14
Baker Bros.....144
Beaman & Smith Co.....15-173
Cincinnati Bickford Tool Co.. 26
Fay Mch. Tool Co.....118
Fosdick Mch. Tool Co.....118
Garvin Machine Co..... 52
Geometric Tool Co.....113
Gould & Eberhardt.....161
Grant Mfg. & Mch. Co..... 70
Hamilton Machine Tool Co.. 34
Modern Tool Co.....174
Niles-Bement-Pond Co..68-69-153
Pratt & Whitney Co.....4-5
Prentiss Tool & Supply Co.... 56
Rockford Drilling Mch. Co...117
Wells & Son Co., F. E.....104
Whitney Mfg. Co.....123
Taps and Dies
Besly & Co., Chas. H.....105
Boker & Co., Hermann.....131
Brubaker & Bros. W. L.....188
Butterfield & Co..... 39
Card Mfg. Co., S. W.....115
Carpenter Tap & Die Co., J. M.....165-Back cover
Cleveland Twist Drill Co., 31-70-Back cover
Geometric Tool Co.....113
Hammacher, Schlemmer & Co. 77
Hardinge Bros.....192
Hart Mfg. Co..... 49
Jessop & Sons, Ltd., Wm.... 49
Lapointe Mch. Tool Co.....128
Modern Tool Co.....174
Morse Twist Drill & Mch. Co.100
Nicholson & Co., W. H.....171
Pratt & Whitney Co.....4-5
Reece Co., E. F.....165
Reed Mfg. Co.....180
Saunders' Sons, D.....190
Smart Mfg. Co., A. J..Back cover
Standard Tool Co..... 55
Ward & Sons, Edgar T.....164
Wells Bros Co..... 92
Wells, Son & Co., F. E.....104
Wiley & Russell Mfg. Co.... 92
Taps, Collapsing
Geometric Tool Co.....113
Tap Wrenches
Marbach Co., F. G.....113
Morse Twist Drill & Mch. Co.100
Wells Bros. Co..... 92
Testing Machines
Sellers & Co., Inc., Wm..... 98
Thermit
Goldschmidt Thermit Co..... 47
Thread Cutting Machinery
Automatic Mch. Co.....154
Besly Co., Chas. H.....105
Bickford & Washburn, Inc....173
Billings & Spencer Co..... 70
Fay Mch. Tool Co.....118
Landis Mch. Co., Inc..... 44
National Mchy. Co..... 63
Pratt & Whitney Co.....4-5
Rivett Lathe Mfg. Co.....194
Wells Bros. Co..... 92
Tire Welders and Benders
Williams, White & Co.....186
Tools
Hammacher, Schlemmer & Co. 77
Pratt & Whitney Co.....4-5
Walworth Mfg. Co..... 3
Tool Cases
Gerstner & Sons, H.....180
Pilliod Lumber Co.....138
Wedell & Boers.....138
Tool Holders
Armstrong Bros. Tool Co.121-150
Beaman & Smith Co.....15-173
Billings & Spencer Co..... 70
Cleveland Twist Drill Co., 31-70-Back cover
Hammacher, Schlemmer & Co. 77
O. K. Tool Holder Co.....189
Osgood, J. L.....172
Pratt & Whitney Co.....4-5
Ready Tool Co.....150
Western Tool & Mfg. Co.....172
Tools, Small
See Machinists' Small Tools.
Tracing Cloth
Keuffel & Esser Co.....151
Tracks, Trolley and Overhead
Yale & Towne Mfg. Co.....129
Transformers
Crocker-Wheeler Co.....143
Eck Dynamo & Motor Co....140
Fort Wayne Elec. Wks.....142
General Electric Co.....141
Reliance Elec. & Eng. Co....140
Roth Bros. & Co.....155
Westinghouse Elec. & Mfg. Co. 142
Transmission Machinery
American Pulley Co.....124
Caldwell & Son Co., H. W....155
Coates Clipper Mfg. Co..... 90
Morse Chain Co.....122
Reeves Pulley Co.....149
Sellers & Co., Inc., Wm..... 98
Wood's Sons Co., T. B..... 51
Trimmers, Wood
Fox Mch. Co..... 67
Trolleys and Tramways
Brown Hoisting Mchy. Co....126
Harrington, Son & Co., Edwin.127
Niles-Bement-Pond Co..68-69-153
Shepard Elec. Crane & Hoist Co. 127
Yale & Towne Mfg. Co.....129
Trolley Wheels
Lumen Bearing Co.....164
Tube Expanders
Watson-Stillman Co.....128
Tubing, Seamless Steel
Almond Mfg. Co., T. R.....177
National Tube Co.....164
Ward & Sons, Edgar T.....164
Tumbling Barrels
Globe Mch. & Stamping Co... 51
Turntables
Sellers & Co., Inc., Wm..... 98
Turret Heads
Almond Mfg. Co., T. R.....177
Turret Machines
Acme Machine Tool Co..... 89
Bradford Mch. Tool Co..... 9
Brown & Sharpe Mfg. Co.... 71
Bullard Mch. Tool Co..... 35
Davis Machine Co., W. P.... 53
Dreses Mch. Tool Co..... 23
Fay Mch. Tool Co.....118
Fay & Scott.....159
Flather Mfg. Co., E. J..... 50
Foster Mch. Co..... 82
Garvin Machine Co..... 52
Gisholt Machine Co..... 97
International Mch. Tool Co.. 65
Jones & Lamson Mch. Co..16-17
LeBlond Mch. Tool Co., R. K. 37-42-43
Lodge & Shipley Mch. Tool Co. 6
Niles-Bement-Pond Co..68-69-153
Potter & Johnston Mch. Co.. 60
Pratt & Whitney Co.....4-5
Prentice Bros. Co., Inside back cover
Prentice Co., Inc., Geo. G.... 52
Seneca Falls Mfg. Co....147-154
Springfield Mch. Tool Co.... 57
Steinle Turret Mch. Co..... 82
Warner & Swasey Co..... 83
Whitcomb-Blaisdell Mch. Tool Co. 99
Windsor Mch. Co..... 85
Turret Machines, Vertical
Bullard Mch. Tool Co..... 35
Flather Mfg. Co., E. J..... 50
Niles-Bement-Pond Co..68-69-153
Twist Drills
Acme Drill Co.....148
Boker & Co., Hermann.....131
Celfor Tool Co.....148
Cleveland Twist Drill Co., 31-70-Back cover
Hammacher, Schlemmer & Co. 77
Lincoln-Williams Twist Drill Co. 84
Morse Twist Drill & Mch. Co.100
National Twist Drill & Tool Co. 64
New Process Twist Drill Co..148
Niles-Bement-Pond Co..68-69-153
Pratt & Whitney Co.....4-5
Standard Tool Co..... 55
Syracuse Twist Drill Co.....182
Union Twist Drill Co..... 29
Ward & Sons, Edgar T.....164
Whitman & Barnes Mfg. Co..149
Wiley & Russell Mfg. Co.... 92
Universal Joints
Baush Mch. Tool Co..... 8
Boston Gear Works.....159
Valves
National Tube Co.....164
Watson-Stillman Co.....128
Valves, Hydraulic
Chambersburg Engr. Co.....185
Vanadium
American Vanadium Co..... 27
Ventilating Apparatus
Sturtevant Co., B. F..... 38
Vise Stands
LeBlond Mch. Tool Co., R. K. 37-42-43
New Britain Mch. Co.....173
Western Tool & Mfg. Co.....172
Vises, Drill
Graham Mfg. Co.....192

Vises, Metal Workers'
Armstrong Mfg. Co.....190
Brown & Sharpe Mfg. Co.... 71
Graham Mfg. Co..... 192
Hammacher, Schlemmer & Co. 77
LeBlond Mch. Tool Co., R. K. 37-42-43
Merrill Bros.....181
Millers Falls Co.....Back cover
Niles-Bement-Pond Co..68-69-153
Prentiss Vise Co.....180
Reed Mfg. Co.....180
Skinner Chuck Co.....178
Walworth Mfg. Co..... 3
Wyman & Gordon.....182

Vises, Pipe
Bignall & Keeler Mfg. Co....191
Butterfield & Co..... 39
Curtis & Curtis Co.....190
Reed Mfg. Co.....180
Saunders' Sons, D.....190
Walworth Mfg. Co..... 3
Wells & Son., F. E.....104
Williams & Co., J. H..... 86

Vises, Plain
Graham Mfg. Co.....192

Vises, Planer and Shaper
American Tool Works Co.... 14
Cincinnati Planer Co..... 19
Hendey Mch. Co..... 13
Niles-Bement-Pond Co..68-69-153
Skinner Chuck Co.....178

Vises, Universal Machine
Becker Milling Machine Co.. 78
Brown & Sharpe Mfg. Co.... 71
Graham Mfg. Co.....192
Skinner Chuck Co.....178

Voltmeters
Bristol Co.....Back cover

Welding
Davis-Bournonville Co.....150
Electric Welding Products Co.139
Goldschmidt Thermit Co.... 47
Standard Welding Co.....130
Thomson Elec. Welding Co..182
Toledo Elec. Welder Co..... 95

Welding Machines, Electric
Thomson Elec. Welding Co..182
Toledo Elec. Welder Co.... 95

Welding Machines, Flue
Rockwell Furnace Co.....133
Ryerson & Son, Jos. T..54A-54B

Wire-Nail and Washer Machinery
Acme Mchy. Co..... 45
National Mchy. Co..... 63

Wire, Vanadium
American Vanadium Co..... 27

Wood Working Machinery
Crescent Mch. Co.....188
Fox Mch. Co..... 67
Greaves, Klusman & Co.....156
Niles-Bement-Pond Co..68-69-153
Seneca Falls Mfg. Co.....147-154

Wrenches
Armstrong Mfg. Co.....190
Bemis & Call Hardware & Tool Co.....Inside front cover
Billings & Spencer Co..... 70
Carpenter Tap & Die Co., J. M. .....165-Back cover
Coes Wrench Co.....70-140
Greene, Tweed & Co..... 96
Trimont Mfg. Co.....191
Walworth Mfg. Co..... 3
Wells Bros. Co..... 92
Wells & Son Co., F. E.....104
Whitman & Barnes Mfg. Co..149
Williams & Co.. J. H..... 86

Wrenches, Pipe
Bemis & Call Hardware & Tool Co.....Inside front cover
Greene, Tweed & Co..... 96
Reed Mfg. Co.....180
Trimont Mfg. Co.....191
Walworth Mfg. Co..... 3
Wells & Son Co., F. E.....104
Whitman & Barnes Mfg. Co..149
Williams & Co., J. H..... 86

Wrenches, Ratchet
Greene, Tweed & Co..... 96
Pratt & Whitney Co.....4-5
Trimont Mfg. Co.....191
Wells Bros. Co..... 92

Wrenches, Tap
Besly & Co., Chas. H.....105
Butterfield & Co..... 39
Card Mfg. Co., S. W.....115
Carpenter Tap and Die Co., J. M. .....165-Back cover
Marbach Co., F. G.....113
Standard Tool Co..... 55
Starrett Co., L. S..... 93
Trimont Mfg. Co.....191
Wells Bros. Co..... 92

POWER SAVING

T. B. WOOD SONS CO.

is an important item in transmission machinery and a factor that has been given careful attention in the

Universal Giant Friction Clutch

This clutch with friction surfaces of large area, compact mechanism and unusual strength is readily applied and adjusted, gives maximum results with minimum wear and is adapted for all classes of service where a friction clutch can be used. Save power with WOOD'S Transmission Machinery.

Catalogue on request.

T. B. WOOD'S SONS CO.

Manufacturing Engineers

CHAMBERSBURG, PA., U. S. A.

BEVEL GEARING

No. 37 in MACHINERY'S Reference Series

MACHINERY'S
REFERENCE SERIES
EACH PAMPHLET IS ONE UNIT IN A COMPLETE LIBRARY OF MACHINE DESIGN AND SHOP PRACTICE REVISED AND REPUBLISHED FROM MACHINERY
N°37
BEVEL GEARING
25 Cents

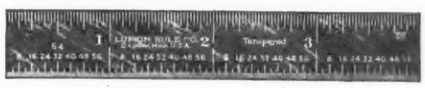
Gives in a plain, understandable way, information needed by the draftsman and machinist for designing and cutting bevel gears. Directions for making the necessary calculations are given in simple rules, as well as in formulas, so that the mathematics will be simple enough for the shop man who does not understand algebra. These rules and formulas are collected in table form with explanatory diagrams, in the most convenient shape for ready reference. A large number of examples are calculated, illustrating the use of rules and formulas. The principles of the action of the various forms of bevel gear cutting machines are explained, and the kinds most commonly used are illustrated and described. Full directions are given for cutting bevel gears in the milling machine or the automatic gear cutter. Special attention is called to the chapter on this subject; and also to the directions and model drawings given in the chapter on design, for guiding the draftsman in furnishing the workman with all the information needed for making and cutting bevel gears.

PRICE 25 CENTS.

See Subscription Offers page 170

LUFKIN STEEL RULES

WITH READABLE GRADUATIONS



Notice how easily the 64ths on this rule can be read. Send for our complete catalog of guaranteed rules and tapes.

THE LUFKIN RULE CO. SAGINAW, MICH., U.S.A.

NEW YORK LONDON, ENG. WINDSOR, CAN.

For Sale Everywhere

Do You Know What SHERARDIZING Is?

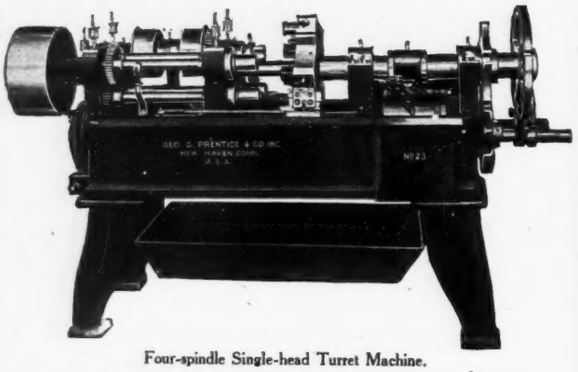
It signifies a **rust-proof** and attractive finish on iron and steel parts. Ask for samples showing finish.

Ask for circular.

The Globe Machine and Stamping Co.

974 Hamilton Ave., CLEVELAND, OHIO

Prentice Automatics



Four-spindle Single-head Turret Machine.

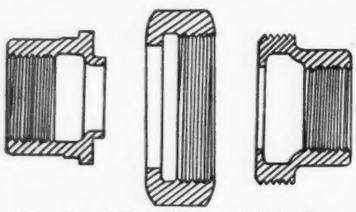
It's not the Number of machines that Counts

Three or four Prentice Automatics might produce all your work where you are now using a dozen others.

A few of them go a long way; economize labor and floor space; simplify the labor problem.

One operator tends 1 to 4 machines, each producing 3 to 5 times more work than by any other method.

And they are adaptable. Jobbers are making handsome profits using them for moderate quantities and frequent changes.



Union Swivel, Nut and Screw. Malleable Iron, (½ size.) Production, ¾" pipe size, 150 ends or 50 complete unions (except pipe threads) per hour.

We would like to figure on your sample castings or forgings and show what you could save.

Catalog "D".

GEO. G. PRENTICE & COMPANY, Inc.

New Haven, Conn.

AGENTS—Alfred H. Schutte, Cologne, Paris, Brussels, Liege, Milan, Bilbao. Schuchardt & Schutte, Berlin, Vienna, Budapest, St. Petersburg, Copenhagen, Stockholm.

Light Up With The Orange Ray—No Shadows

The new A-B Regenerative Flame Lamp is the ideal means of lighting shop, factory, mill yard and furnace.

Gives an enormous gain in light intensity at a low cost. Burns the same current as one 5-ampere carbon lamp, but the carbons last 70 hours instead of 16 and give an exceedingly brilliant orange light.

Casts no shadows

If you want an intense, economical light harmless to the eyes, needing little attention and throwing no shadows, let us tell you more about the A-B Regenerative Flame Lamp.

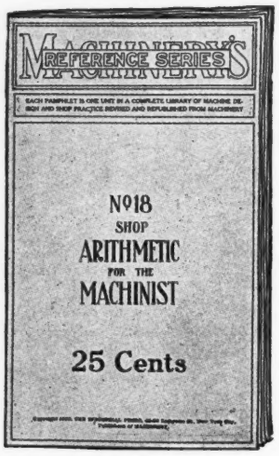
Bulletins on request.

The Adams-Bagnall Electric Co.

CLEVELAND, OHIO

NEW YORK OFFICE 40 Wall Street — PHILADELPHIA, PA. SCRANTON, PA. ATLANTA, GA. — CHICAGO OFFICE 903 Dearborn Street

MACHINERY'S Reference Series—No. 18



No. 18—Shop Arithmetic for the Machinist.—This twenty-five-cent book contains more information of direct application to the needs of the practical shop man than will be found in nine out of ten textbooks that sell for two, three or even four dollars. If that is not true you can return the book by mail and get your money back. Contents:—Introduction—Figuring Tapers—Setting Over the Tail-Stock for Turning Tapers—Cutting Speeds and Feeds—Rules for Calculating Cutting Speeds—Feed of Cutting Tools—Time Required for Turning Work in the Lathe—Screw Threads and Tap Drills—Trains of Gears—Compound Gearing—Lathe Change Gearing—Finding the Lathe Screw Constant—Change Gears for Simple Gearing—Compound Gearing—Speed of Pulleys—Change Gears for Milling Spirals—Lead of Milling Machine—Milling Machine Indexing—Finding the Index Circle to Use—Indexing for Angles.

Address MACHINERY

49-55 Lafayette Street, New York, N. Y.

PEERLESS High Speed Steel

Write us for particulars

Also full line regular Crucible Steels and Steels for special needs.

HELLER BROS. CO., Newark, N. J.

The Garvin Machine Co.

Spring and Varick Sts., New York

Milling Machines, Screw Machines, Turret Lathes

FULL LINE HIGH GRADE MACHINE TOOLS

WET TOOL GRINDERS

The BEST Machines on the market for the price.

16" - $60.00. 24" - $90.00.

Equipped with NORTON "ALUNDUM" Wheels.

NO Pump. Simple and VERY Efficient.

HOYSRADT & CASE, KINGSTON, N. Y.

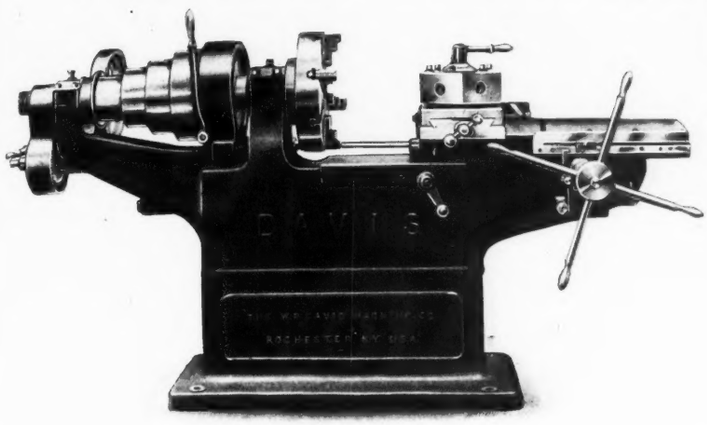
CONTRACT WORK

We use HIGH SPEED STEEL to make our prices right. We finish by grinding to make our work right.

The Blanchard Machine Co Boston Mass

Save Money on Duplicate Machine Work

The Davis Turret Head Boring and Forming Lathe

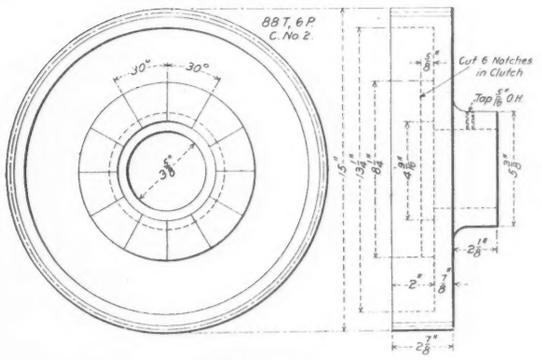


24" Davis Turret Boring and Forming Lathe.

is one of the most rapid as well as most versatile machines you can put in your shop. The turret has six faces, carries a complete equipment of tools and permits performing a variety of operations at one setting of the piece, with a consequent time and labor saving that can hardly be duplicated.

A Typical Piece of Work

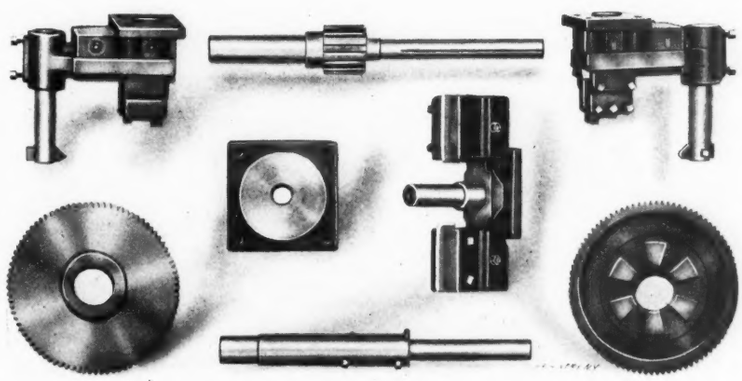
is the Clutch Gear as shown. There are a number of operations on this piece, difficulties to overcome and a very close degree of accuracy demanded. The hole is both bored and reamed and the clutch is turned and faced on the inside as well as the outside.



Clutch Gear.

45 to 50 Minutes

is the average time required on the Davis machine to finish such a piece. The tools are of the latest improved patterns, designed for rapid and accurate production and are brought into operation in turn. Maintained alignment and rigidity of cutting tools are strong points in favor of the Davis and a wide range of usefulness increases its value.



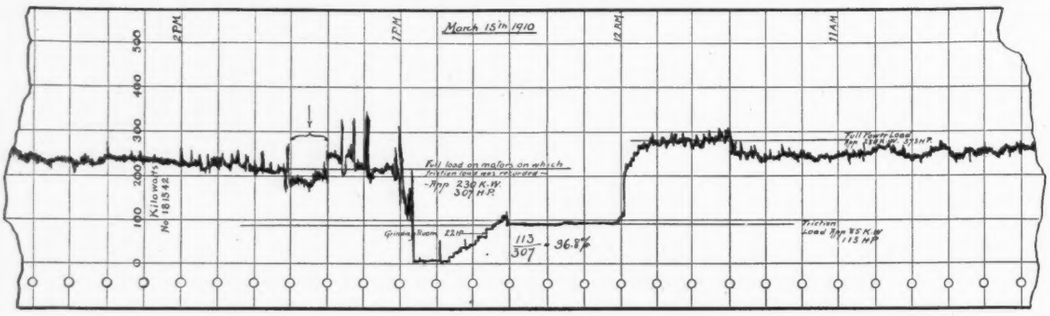
Tools used for forming Clutch Gear as shown.

We shall be glad to give full description or answer any questions.

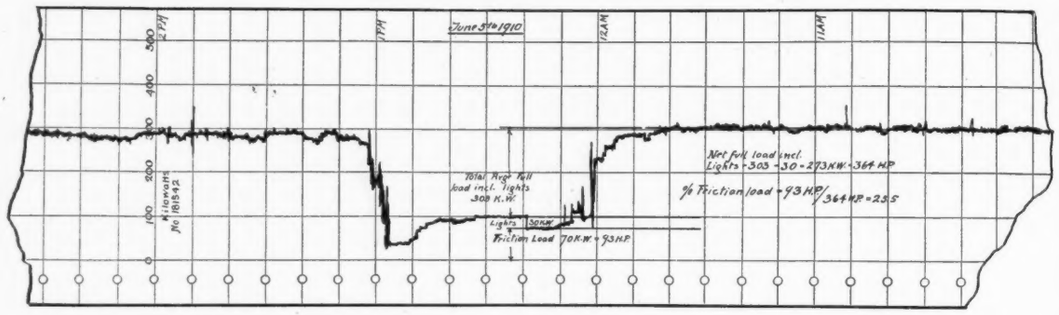
The W. P. Davis Machine Company

ROCHESTER, N. Y., U. S. A.

$1000 a Year Saved in Power


March 15th 1910
2 P.M.
1 P.M.
12 M.
11 A.M.
Kilowatts No 181542
Full load on motors on which friction load was measured = App 230 K.W. 307 H.P.
113/307 = 36.8%
Friction load 71 K.W. 93 H.P.

Reading taken before shafting was lined up with the Kinkead Shaft Leveler.


June 3rd 1910
2 P.M.
1 P.M.
12 A.M.
11 A.M.
Kilowatts No 181542
Total Avge full load incl. lights 309 K.W.
Net full load incl. Lights = 305 - 30 = 273 K.W. = 364 H.P.
% Friction load = 93 H.P./364 H.P. = 25.5
Lights 30 K.W.
Friction Load 70 K.W. = 93 H.P.

Reading after the shafting was lined up—showing friction saved.

The two charts above are actual readings before and after the shafting in a large manufacturing plant was lined up with the Kinkead apparatus. The first chart shows the friction load to be 113 H.P., or 36.8 per cent. of the total load. After lining up, the friction load shows as 93 H.P., 25.5 per cent. of the total load, a saving of 20 H.P.—or an actual money saving of over $1000 a year for electric power. In this case 2350 feet of shafting were lined up in 52 hours, the work was done in the evenings and without an hour's loss of working time. Previously the same aligning required two weeks' time and the plant was shut down.

The Kinkead Device is so simple any mechanic can use it. Alignment as well as the level is given in one operation. Two men can adjust any line shaft, do the work in a fraction of the time required by other methods, and the device can be operated after working hours.

Wouldn't it be wise to figure what your power loss may be? Our advice is at your service if you will fill in the coupon below.

Kinkead Manufacturing Co.

7 Water Street, BOSTON, MASS.

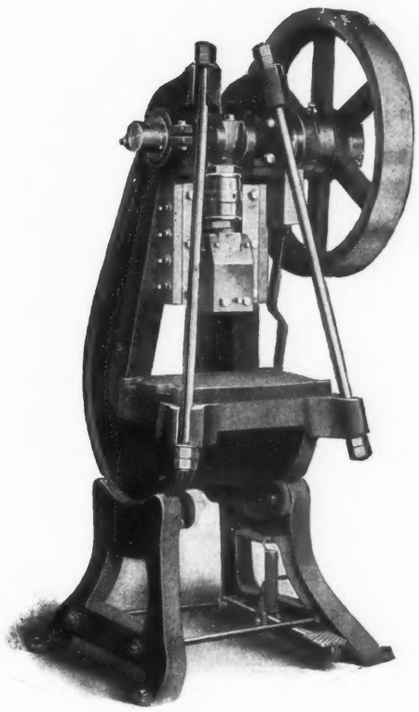
KINKEAD MFG. CO., 7 Water Street, Boston, Mass.

Your representative may call and give us a demonstration with your apparatus for aligning and leveling shafting, the same to be without expense to us.

We have approximately.....feet of shafting.

Name..... Street.....

City..... State.....



RYERSON PRESSES

We are now prepared to offer a complete line of presses for all kinds of drawing, punching, trimming and forming. Our line embraces presses of both the upright and inclinable types, geared and direct acting, also single and double crank presses, toggle presses, etc.

All Ryerson presses are designed embodying the latest features and improvements of press construction, and our mechanical engineering department is prepared to give estimates and make recommendations in regard to the manufacture and use of proper dies for the various classes of work.

We will endeavor to carry a full line of presses in stock for immediate shipment.

ESTABLISHED 1842 INCORPORATED 1888

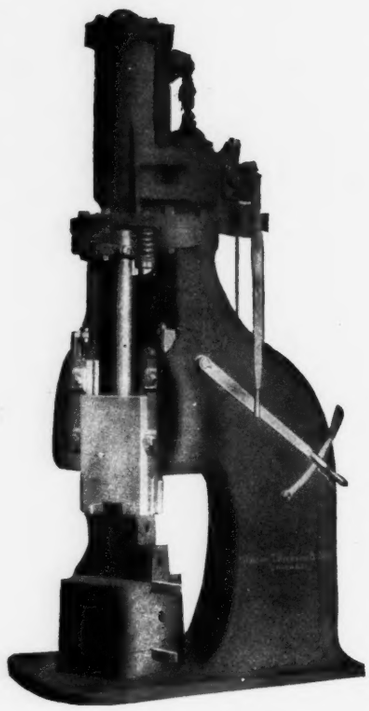
JOSEPH T. RYERSON & SON

EDWARD L. RYERSON, PRES. CLYDE M. CARR, VICE-PRES.

IRON STEEL MACHINERY

CHICAGO

New York Office: Hudson Terminal Building



RYERSON STEAM HAMMERS

We offer a complete line of single and double frame steam hammers from 100 to 2500 lbs. inclusive. Ryerson hammers are designed to do the heaviest kind of forge work for their respective sizes. Adjustable guides are provided for taking up the wear of the ram, steel tapered shoes extending the full length of the guides. The seat is easily removable and so constructed that it takes up its own lost motion by gravity.

Steam and exhaust connections have stuffing box joints. Piston rings are so arranged that they can be easily replaced or examined without removing the rod from the ram. The piston rod glands are made in halves in order to permit their being easily removed. Valves and cylinder are automatically lubricated by means of an automatic oil pump mounted on the frame.

Ryerson hammers embody the best features of all steam hammers now on the market. Their design insures the minimum amount of wear and the greatest accuracy and sensitiveness to the control of the operator.

Write for catalogue and prices.

ESTABLISHED 1842 INCORPORATED 1888

JOSEPH T. RYERSON & SON

EDWARD L. RYERSON, PRES. CLYDE M. CARR, VICE-PRES.

IRON STEEL MACHINERY

CHICAGO

New York Office: Hudson Terminal Building

THE STANDARD TOOL CO'S TAPS

STANDARD TOOL CO.

Quality is the important feature in Taps. That same quality depends, not alone upon one operation, but upon every condition and phase of their manufacture.

Material especially made for Taps, a corps of men whose skill in their construction is of the highest caliber and a department especially equipped for the purpose, enable us to produce Taps which cannot be excelled for accuracy, free-cutting qualities and long life.

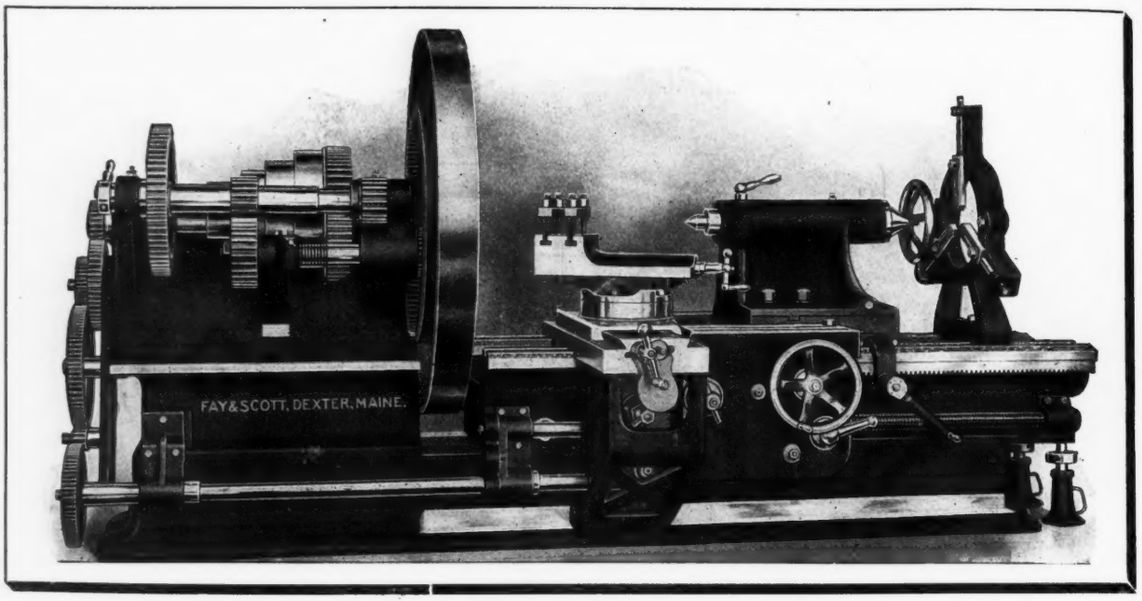
We make them for all purposes.

It's to your advantage to use them.

WE WELCOME INQUIRIES.

New York: 94 Reade St. **Cleveland: 6900-7000 Central Ave.**

C. W. Burton, Griffiths & Co., London. Burton Fils, Paris. J. Lambercier & Cie, Geneve. F. W. Horne, Yokohama, Japan.
Honore Demoor & Co., Bruxelles. Nienstaedt & Co., Copenhagen.



THIS EXTENSION GAP ENGINE LATHE

One of the well known FAY & SCOTT Line

This movement is readily accomplished by means of screw and crank at the rear end, and not only increases the swing of the lathe, but also increases the distance between centers, permitting long work to be turned.

The gap is a thoroughly practical, range-widening feature with no awkward or unhandy complications to interfere with regular work, and rounds out the usefulness of an all-around good lathe.

Fills the need in the machine building trade between a tool capable of turning work of large diameter and extra length and one designed for ordinary work, by doing **both classes of work.**

An extremely powerful, rigid, well-fitted machine which, while fully covering the every day duty for a lathe of its regular swing, has a further advantage. By sliding the top bed of the machine the gap can be widened or reduced to suit any requirement.

Write us for circulars and detailed description.

DISTRIBUTORS

THE PRENTISS TOOL & SUPPLY CO.

115 Liberty Street, New York, U. S. A.

BOSTON, MASS.	SCRANTON, PA.	SYRACUSE	BUFFALO
145 Oliver Street	729 Prescott Avenue	520 University Block	607 D. S. Morgan Building

All Roads Lead to Springfield

If you are Seeking High Grade Machine Tools

18-inch Engine Lathe with Turret on Special Carriage

Building our machines from the castings up we know that only the best material goes into them, a trained force of employees assures the finest workmanship, constant supervision of even the smallest operation keeps the "Springfield Quality" always to the fore.

SPRINGFIELD LATHES

are made in all possible combinations and join latest improvements and most practical advantages to the strongest and most powerful forms of construction.

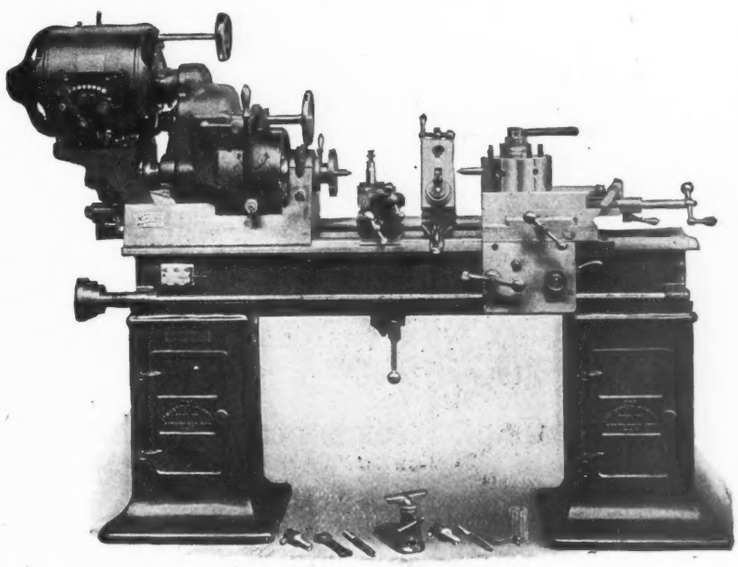
The **18" Engine Lathe,** as shown, has Friction Geared Head and Turret on Special Carriage, but when so ordered can be furnished without friction geared head. It is one of the handiest machines for the automobile or engine shop, combining as it does the advantages of the turret lathe with the ordinary functions of the engine lathe, and is a cost reducer of the first order.

Circular No. 116 gives full description.

Our Motor Driven Brass Finishing Lathe

is also a rapid producer and one of the best examples of improved design. New indexing and locking mechanism for the turret, improved chasing device and the new compound rest are interesting features of this machine.

Circular No. 105 describes it.



18-inch Brass Finishing Lathe. Motor Driven

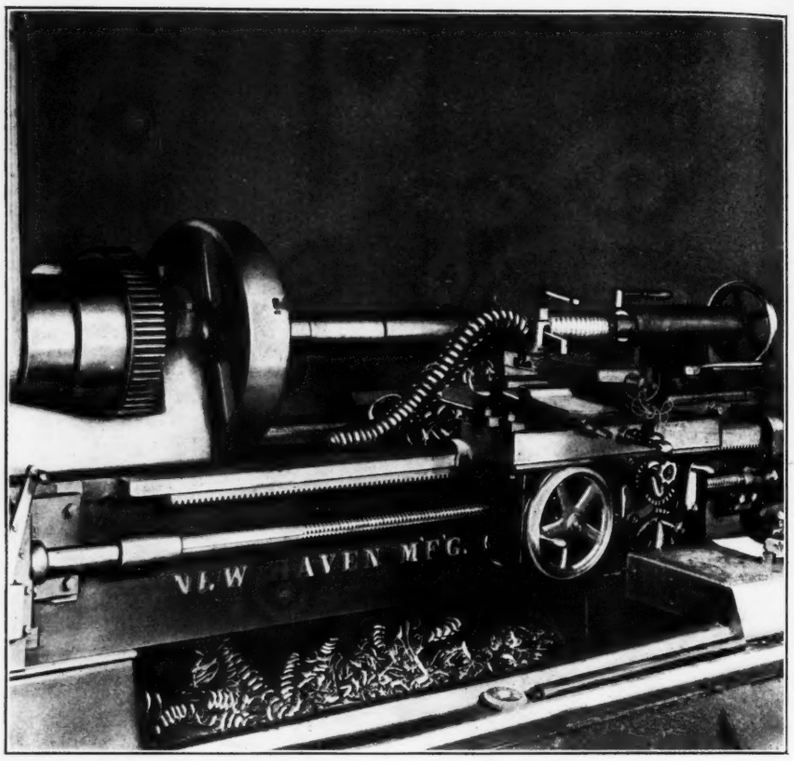
We shall be glad to send catalogue of the full Springfield line on request.

THE SPRINGFIELD MACHINE TOOL CO.

631 Southern Avenue, **SPRINGFIELD, OHIO, U. S. A.**

Agents for Germany, Ludw. Loewe & Co., Berlin. Agents for Italy, Stussi & Zweifel, Milan.
McDowell, Stocker & Co., and The E. L. Essley Machinery Co., Agents for Chicago, Ill. Geo. E. Neil, Cleveland, Ohio.

For High Speeds and Heavy Feeds there is no Steel that meets "BLUE CHIP"



The engraving shows a 24" New Haven double back geared lathe equipped with "Blue Chip" steel tool, turning a .35 carbon steel bar, 5" diameter. Cutting speed, 75 feet per minute. Feed 3-32" per revolution. Reduction in diameter, 1".

For big reductions and heavy work of this class, "Blue Chip" steel tools are without equal. They will stand more service without regrinding than any competing steel, meet "meaner" conditions and will cut harder metals.

As as example of "hard" cutting, on this same machine "Blue Chip" tools were used for turning a .75 Carbon steel bar, 2⅝" diameter, Cutting Speed 145 feet per minute, Feed 1-16" per revolution, with ⅜" reduction in diameter—and did the job to the "Queen's taste".

"Blue Chip" Steel is not only adapted for Cutting Tools of all kinds, Punches, Dies, etc., but is furnished in grades to suit a wide range of specific purposes and to meet all conditions efficiently and economically.

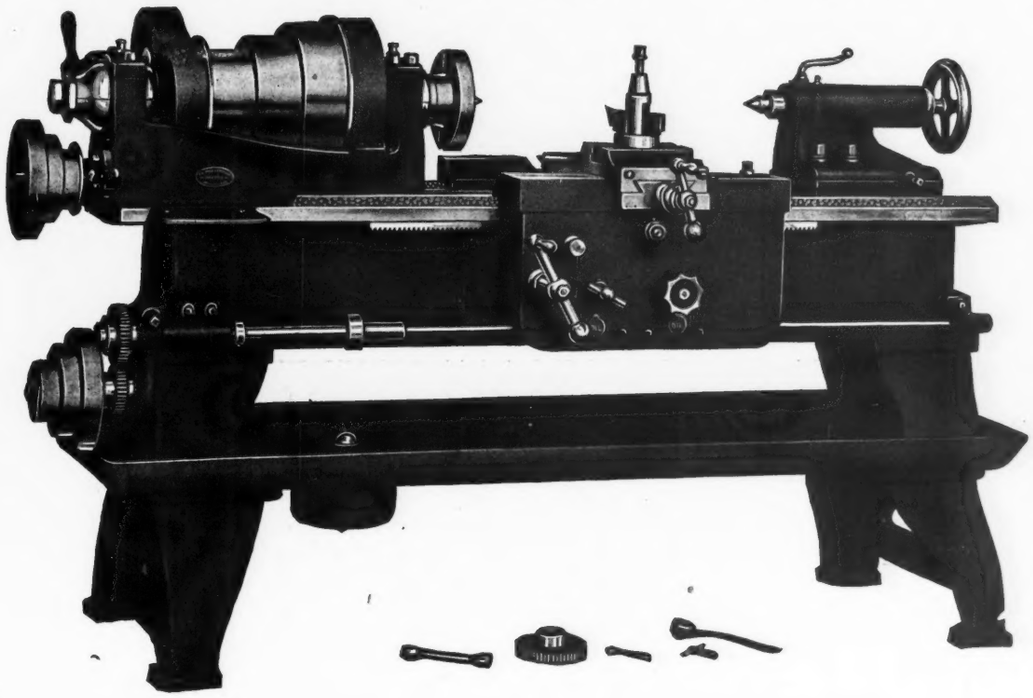
If you are a steel user in any shape, we shall be glad to confer with you.

FIRTH-STERLING STEEL COMPANY

McKeesport, Pa. New York Boston Philadelphia Chicago San Francisco

Reed Lathes are Good Lathes

Good from every point of view—material, workmanship, design, operation—good for long service, good work, and good profits.



In redesigning the line to better meet modern conditions, Reed Lathes have been made heavier, stiffer, more powerful, but the simplicity and ease of operation for which the tools are famed is still maintained.

The 14" Heavy Plain Turning Lathe

is an example of this added power. Designed for the severest grades of work, construction throughout is the heaviest ever put into a lathe of this swing. In rigidity and power it fully equals the ordinary 20″ machine and has an even capacity. "Extra heavy" is not a selling phrase, but a plain description of the lathe which is invaluable for heavy turning of all kinds and especially adapted for the rapid production of engine, automobile and other machine parts.

Complete catalogue on request.

F. E. REED COMPANY, Worcester, Mass.

SELLING AGENTS—**MANNING, MAXWELL & MOORE, Inc., 85-87-89 Liberty St., New York, N. Y.**

111-115 No. Canal St., Chicago, Ill.
Merrill Building, Milwaukee, Wis.
Kirk Building, Syracuse, N. Y.
White Building, Buffalo, N Y.
Cor. Oliver & Franklin Sts., Boston, Mass.
Frisco Building, St. Louis, Mo.
Atlanta, Ga., Candler Building.
Indianapolis, Ind., Ter. Trac. Building.
721 Arch St., Philadelphia, Pa.
Majestic Building, Detroit, Mich.
San Francisco, Cal., Monadnack Building.
1262 Ontario St., Cleveland, O.
Park Building, Pittsburgh, Pa.
Mexico City, Mexico.
Yokohama, Japan.

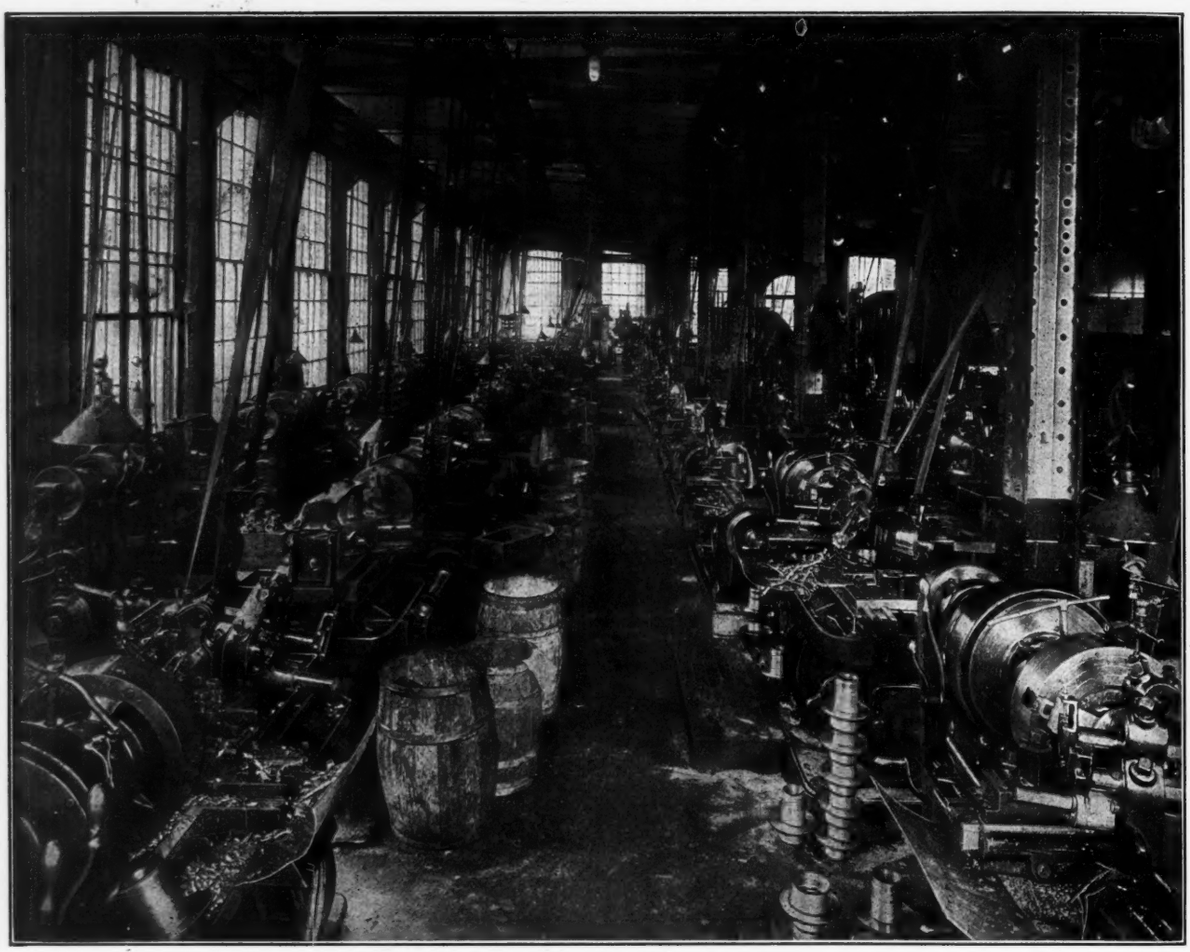
Thomas & Lowe Machinery Co., Providence, R. I. Syracuse Supply Co., Syracuse, N. Y. Chas. A. Strelinger Co., Detroit, Mich. Fenwick Freres & Co., Paris, France. Chas. Churchill & Co., Ltd., London, Eng. The A. R. Williams Machinery Co., Ltd., Toronto, Ont. Van Rietschoten & Houwens, Rotterdam, Holland. G. Koeppen & Co., Moscow, Russia. C. & J. W. Gardner Co., St. Petersburg, Russia. Graham Bros., Stockholm, Sweden. F. G. Kretschmer & Co., Frankfort, a. M., Germany.

POTTER & JOHNSTON
MANUFACTURING AUTOMATICS

Cut below shows a Battery of Thirty-one (31) Automatics installed in one of the leading automobile shops. This is nothing extraordinary, however, as some shops are using as many as fifty machines, others seventy-five machines.

For all duplicate work ranging in diameter from 2 inches up to 20 inches and up to 10 inches long—either cast iron, steel, bronze, or forgings—POTTER & JOHNSTON MANUFACTURING AUTOMATICS can be employed to advantage.

One Attendant Operates from Two to Six Automatics.



"The proof of the pudding is in the eating of it." Send us samples or drawings of your work and we will cheerfully show you what the Manufacturing Automatics will do.

POTTER & JOHNSTON, Pawtucket, R. I., U. S. A.

OFFICES AND REPRESENTATIVES—Office for GreatBritain and France: 78 Avenue de la Grande Armee, Paris, J. Ryan, Manager. New York Office: Fulton Bldg., 50 Church St., Walter H. Foster, Manager. Cleveland Office: Modern Machinery and Engineering Co., 309 Schofield Bldg. Milwaukee Office: 794 National Avenue, Chas. H. Shaw, Manager.

FOREIGN AGENTS—Chas. Churchill & Co., Ltd., London, Birmingham, Manchester and Newcastle-on-Tyne, England, and Glasgow, Scotland. Alfred H. Schutte, Cologne, Brussels, Liege, Milan, Barcelona, Bilbao. Schuchardt & Schutte, Berlin, Vienna, Stockholm, St. Petersburg, Copenhagen, Budapest.

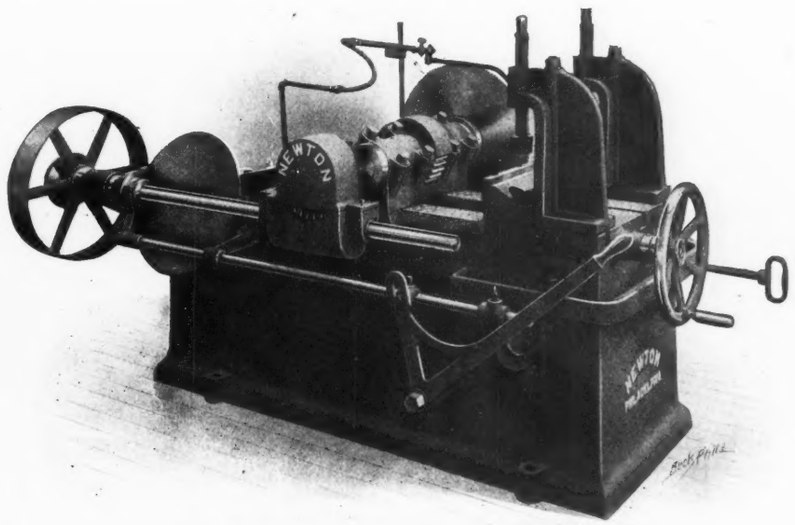
NEWTON

(REGISTERED TRADE MARK)

High Duty Radial Drilling Machines **Horizontal Floor Boring Machines**

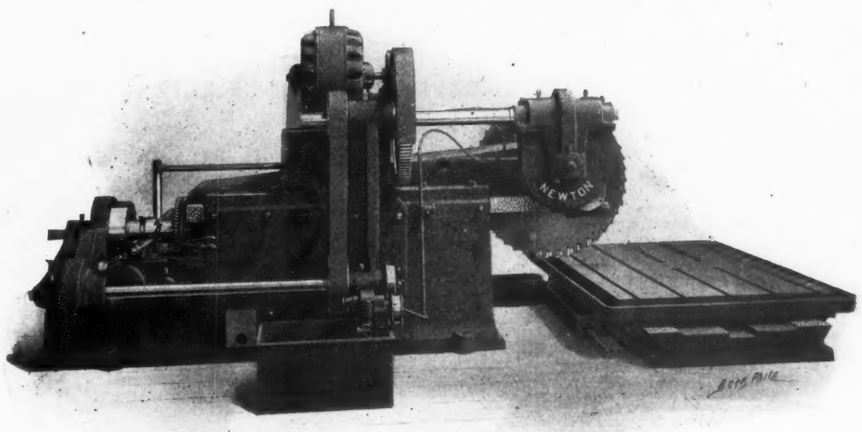
Rotary Planing Machines, Fixed, Portable or on Round Base

Fixed Slotting Machines, Rack or Crank Driven and Portable Screw Driven Machines



20" BLADE BAR COLD SAW CUTTING-OFF MACHINE

The 20" blade bar saw, illustrated above, is the smallest machine built, capable of obtaining the maximum output from high speed inserted tooth saw blades.



40" BLADE STEEL FOUNDRY COLD SAW CUTTING-OFF MACHINE

The 40" diameter blade Steel Foundry Saw, illustrated, embodies the very latest features in design, facilitating operation, and is of massive construction, with powerful drive necessary for continuous service in Steel Foundries.

This ram type, in addition to giving ample wearing surface, affords a perfectly rigid support for the spindle when in its outermost position.

Machines are furnished with nine gear changes of feed having adjustable automatic and positive safety release and power quick return, and are arranged for belt or direct motor drive as desired.

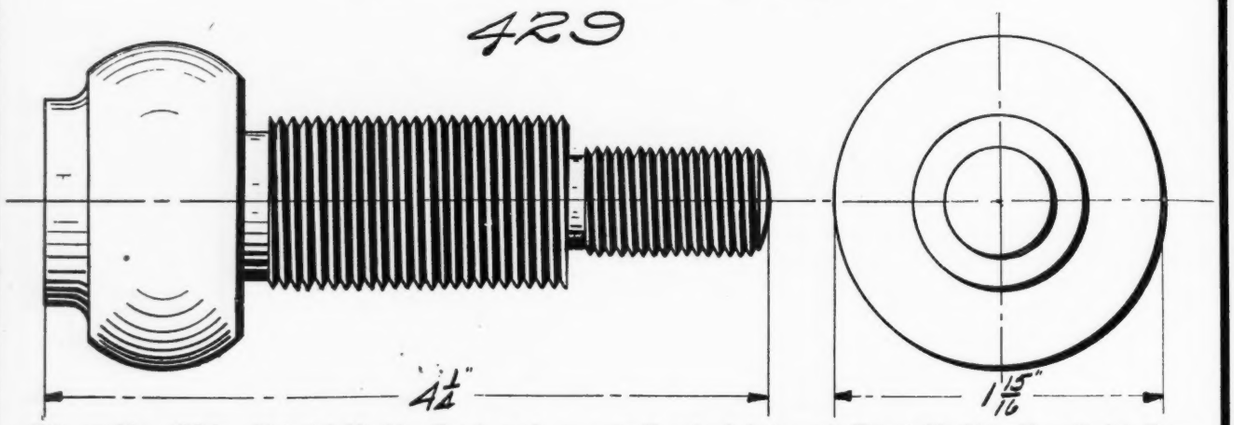
Newton Machine Tool Works, Inc.

Philadelphia, U. S. A.

FOREIGN REPRESENTATIVES—Berlin, Heinrich Dreyer. Vienna, Rudolf Salzer. Italy, Spain Switzerland, Belgium and France Fenwick Freres & Co. Paris, France

Doing Any Work of this Kind in Your Shop?

429



Piece No. 429. Material, Machine Steel; made on a 2" Cleveland Automatic Turret Machine, New Model; Time for all operations, 7½ minutes. Send in samples or drawings; we will send you complete specifications explaining outputs, cost of machines, and tools, etc., etc.

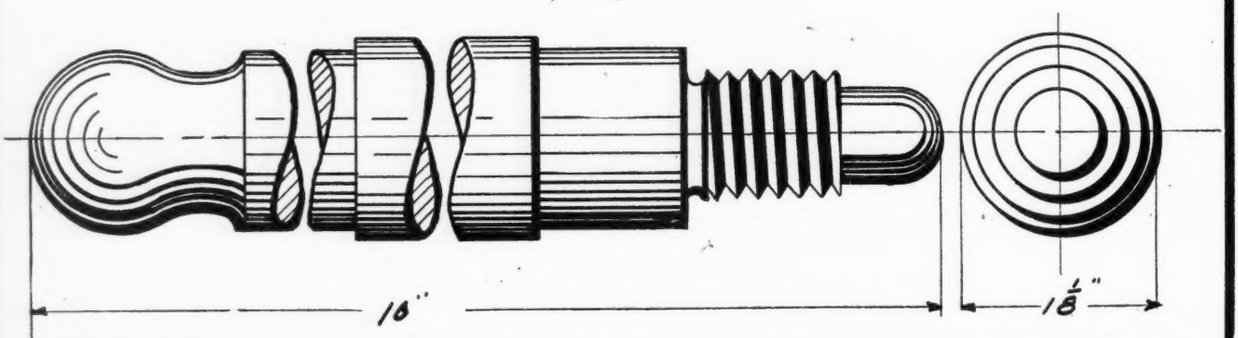
Compare your figures with those we give for the Cleveland Automatic.

We have cyphered it down to the finest point, built our machines to cover the whole field, to meet extraordinary conditions or just handle everyday work, but we can save time, save labor and save money on every piece we turn out—

The Pre-eminence of the "Cleveland" is Indisputable.

Capacities 1 inch to 6¾ inch. Operating Expense, One Mill a Minute. Your overhead charges added to this will give you the exact cost per piece.

498



Piece No. 498. Material, Cold Rolled Steel; made on a 2" Cleveland Automatic Turret Machine, New Model; output, 9 per hour. Send in samples or drawings; we will send you complete specifications explaining outputs, cost of machines, and tools, etc., etc.

CATALOGUE ON REQUEST

Cleveland Automatic Machine Co.

Cleveland, Ohio, U. S. A.

Eastern Representative—J. B. Anderson, 2450 No. 30th St., Philadelphia. Western Representative—Herbert E. Nunn, 562 Washington Boulevard, Chicago. Foreign Representatives—Chas. Churchill & Co., London, Manchester Birmingham, Newcastle-on-Tyne and Glasgow. Messrs. Schuchardt & Schutte, Berlin, St. Petersburg, Stockholm, and Copenhagen. Donauwerk Ernst Krause & Co., Vienna, Prague, Budapest.

EXPOSITION
AUGUST 22-23

Modern Bolt, Nut and Forging Machinery TIFFIN, OHIO

We will exhibit in our Shops at Tiffin on August 22d and 23d, a full assortment of Bolt, Nut and Forging Machinery (over 50 machines) presenting many *new* and *improved* designs for the consideration of the progressive manufacturer. Most of the Machines will be in operation giving practical demonstrations.

We deem an exhibit of this kind a mutual benefit both to manufacturer and consumer, and we earnestly solicit the attendance of every user of bolt, nut or forging machinery at our Shops August 22d and 23d.

Tiffin is easy of access, having good R. R. connections and we assure every National guest of modern hotel conveniences and accommodations on the above dates, *if notified of his intention to attend.*

Full information regarding R. R. connections, conveniences, etc., will be gladly supplied upon request.

THE NATIONAL MACHINERY CO.
TIFFIN, OHIO, U. S. A.

To be exhibited for the first time—

NEW
- **Motor Drive Forging Machines.**
- **Semi-Automatic Nut Burring Machines.**
- **Semi-Automatic Nut Tappers.**
- **Automatic Feed Rivet Machines.**
- **Continuous Rivet Machines.**
- **Vertical Roll Thread Machine**

and others.

THE NATIONAL MACHINERY CO TIFFIN, OHIO, U.S.A.

The 60 Horse Power Twist Drill

NATIONAL

NOVO

SUPERIOR

High Speed Twist Drills

THREE SPEEDS FORWARD **1911** ONE SPEED REVERSE

For Faster Cutting, Greater Output, Longer Service and Bigger Profits specify the National—NOVO—Superior Twist Drills. All current sizes in stock. Price list and discounts on request.

National Twist Drill & Tool Co.

Detroit, Mich., U. S. A.

Also manufacturers of High Speed and Carbon Twist Drills.

PRICE OF OILDAG REDUCED

The factory facilities for making OILDAG have been so improved and increased that we are pleased to announce a

60% CUT IN PRICE

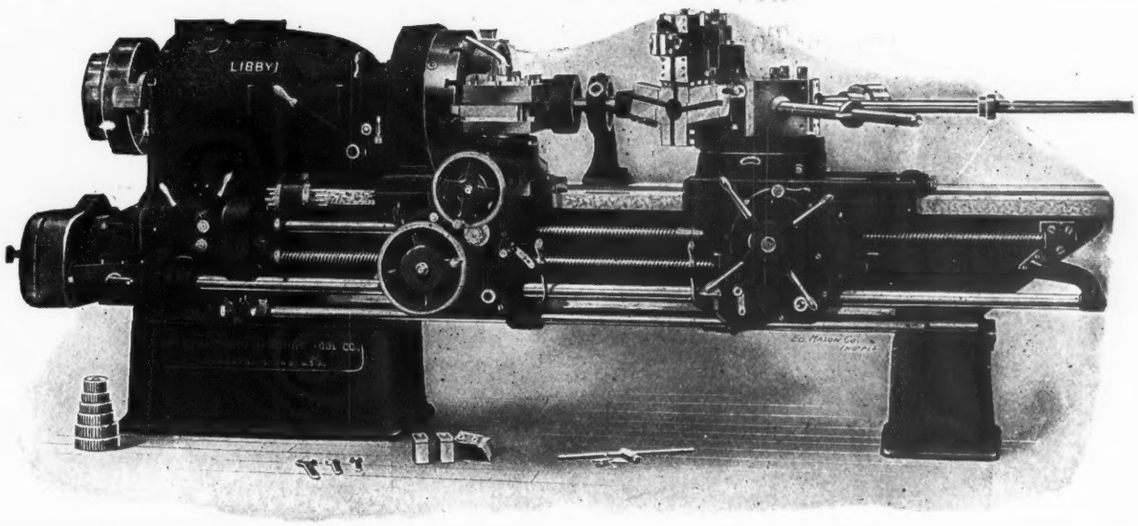
The present selling price makes it possible for all users of lubricants to enjoy the benefit and economy of using OILDAG. It contains Deflocculated Acheson-Graphite, which remains in suspension.

The graphite with the oil will accomplish more than twice the work of oil alone, and makes possible the use of cheaper oils.

It is to the interest of every Machine Tool Builder and every Machine Shop to know the great merit possessed by OILDAG as a lubricant.

WRITE TODAY FOR PRICES AND BOOKLET 47-F.

ACHESON OILDAG COMPANY, NIAGARA FALLS, N. Y.



"THE MACHINE TOOL HOG"

Faster Work Means Lower Costs

The "Libby" Full Swing Side Carriage Turret Lathe Gives Both

This lathe embodies in its design the latest and best ideas in lathe construction, will help you to reduce your manufacturing costs, and is a tool which in quality and working efficiency cannot be surpassed at any price.

The unusual strength and power of the "Libby" Lathe permit handling a gang of extra size tools and taking extra heavy cuts with as much ease as the old style machines took the light stroke with a single tool. Particularly valuable for manufacturers of Automobile, Gas Engine, and duplicate parts of all kinds.

It will pay you to investigate. **Descriptive catalogue on request.**

THE INTERNATIONAL MACHINE TOOL CO., Indianapolis, Ind., U. S. A.

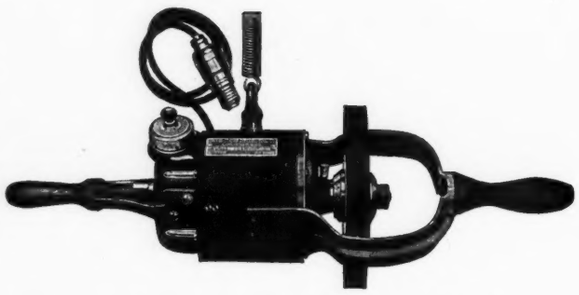
Minimize Your Drilling and Grinding Troubles

BY EQUIPPING YOUR SHOP WITH

United States Portable Electric Tools

Don't move heavy castings and material clear across the shop from one machine to another—
Simply carry the U. S. Drill or Grinder to your work, attach to the nearest electric light socket and you are ready for business.

U. S. Portable Tools increase the capacity of your shop by enabling one man to do the work of five, and increase the profits by reducing operating time.



Made in all standard types and sizes to operate on both A. C. and D. C. circuits.

If you are interested in reducing shop costs, saving time and labor, write us today. We will send any one of our tools on trial.

Ask for a copy of our Catalog "G" which is a complete reference book of U. S. Portable Tools.

The United States Electrical Tool Co.

Cincinnati, Ohio, U. S. A.

FOREIGN AGENTS—The Canadian-Fairbanks Co., Ltd., Montreal, St. John, Toronto, Winnipeg, Calgary, Vancouver. Agents for Sweden: Wilh. Sonesson & Co., Malmo, Stockholm and Gothenburg. Agents for Denmark, Norway and Finland: Aktieselskabet Wilh. Sonesson & Co., Copenhagen City and Freeport. Selson Engineering Co., Ltd., London, England. J. S. Cock, Christiania, Norway. E. Sonnenthal, Berlin, Germany. Glaenzer, Perreaud & Thomine, Paris, France. Hans Schulze, Bruenn, Austria. Andrews & George, Yokohama, Japan.

The Range of Work Covered by the New Rockford Miller

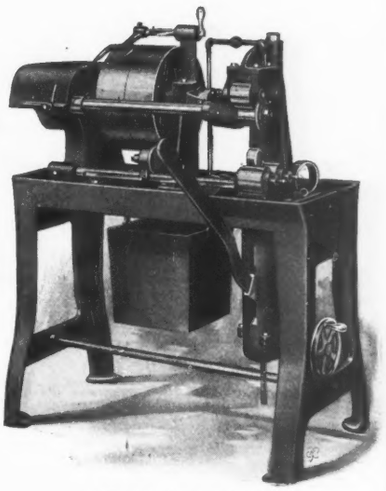
Makes this machine particularly valuable for the tool room or general manufacturing shop. It is equally well adapted for vertical or horizontal milling, for slotting, die work and a great variety of special milling, both light and heavy. The combination screw and lever feed is an advantage that will appeal to every practical mechanic. The line of attachments is complete and special methods of attaching these add to the efficiency and convenience of the tool.

Let us send Catalogue and further details.

National Machine and Tool Works
Rockford, Illinois, U. S. A.

Fox Pipe Cutters

For Cutting
Bicycle Tubing
Auto. Tubing
Boiler Flues
Steam Pipe
Plumbers' Fittings
IN FACT
All Kinds of Pipe and Tubing



No. 6 PIPE CUTTER

THINK! Of Cutting a 4-in. Boiler Flue IN 10 SECONDS!

Write TODAY for our General Catalog No. 45

FOX MACHINE COMPANY
1608 Front Street, **Grand Rapids, Mich.**

ANOTHER NEW KERN

A High Speed Ball Bearing Sensitive Drill

exceedingly simple in design, sufficiently heavy and powerful for hard, continuous service and at the same time extremely sensitive.

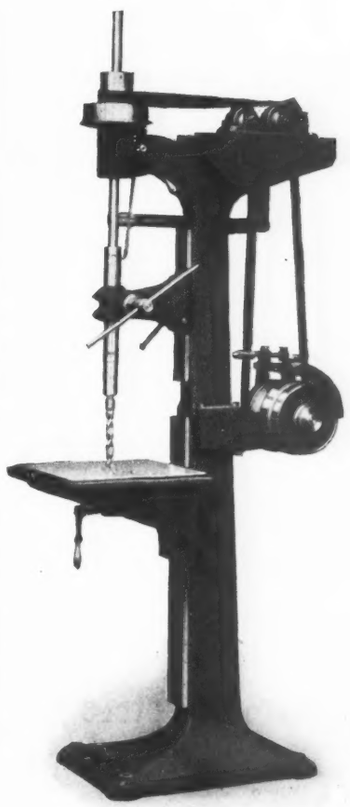
It is made with from one to six spindles and has a number of exclusive features. The spindle cone with a large sleeve bearing journaled in the column, relieves the spindle of any belt pull and insures permanent alignment.

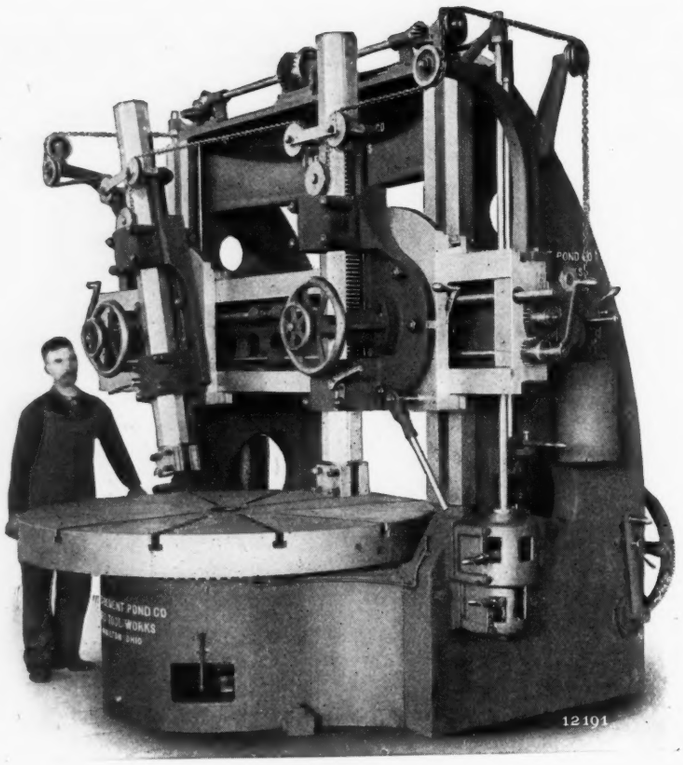
A convenient lever on the left-hand side near the top of the column controls the belt tension, allows four speed changes to be instantly made and automatically locks the idler carriage.

Full description is well worth the attention of manufacturers who want the best drills.

THE KERN MACHINE TOOL CO., Cincinnati, O.

AGENTS—Manning, Maxwell & Moore, Cleveland and San Francisco. Chandler & Farquhar Co., Boston. C. H. Wood Co., Syracuse. The Chas. A. Strelinger Co., Detroit. Aumen Machinery and Supply Co., Baltimore. The E. A. Kinsey Co., Cincinnati and Indianapolis The E. L. Essley Machinery Co., Chicago and Milwaukee. Fairbanks Co., New Orleans. Crane Co., Birmingham. Hendrie & Bolthoff Mfg. & Supply Co., Denver. J. W. Wright & Co., St. Louis. Williams & Wilson, Montreal. A. R. Williams Machinery Co., Toronto. Alfred Herbert, Ltd., Coventry and Paris. De Fries & Co., Dusseldorf and Milan. G. Koeppen & Co., Moscow. J. Lambercier & Co., Geneva. Nienstaedt & Co., Copenhagen. E. Isbecque & Co., Antwerp Van Rietschoten & Houwens, Rotterdam.





72-in. Niles Boring Mill

Exceptional Facilities

for Special Operations on

NILES BORING MILLS

Central boring, drilling and facing head with independent drive and feed. Chasing attachment through lead screw or bar rack. Turret head on right hand saddle with five faces. Slotting head with adjustment for length and position of stroke. Taper boring and turning attachment. Side heads with or without taper attachment. Crowning attachment for pulley and fly wheel turning. Grinding attachment. Various forms of 3 or 4-jaw chucks for facilitating rapid handling of large lots. Each one represents splendid economy where it is difficult or not propitious to repeat a setting.

Write for Catalog "Niles Mills."

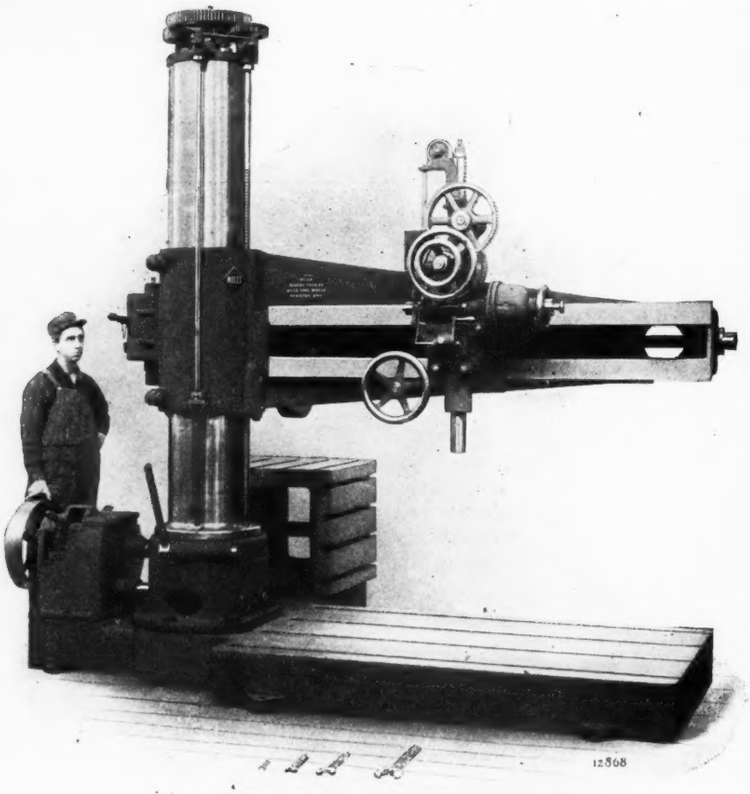
A Radial Drill with a Past as well as a Future—

THE NILES & POND RADIAL DRILLS

Past performances and past records reaffirm and corroborate all previous statements.

For accurate and consistent drilling at high speed no claims can be too extravagant in proclaiming the Niles and Pond Radials leaders in radial drilling.

Write for Catalog "Radial Drills."



6-ft. Niles Semi-Universal Radial Drill

Niles Electric Traveling Cranes

NILES-BEMENT-

111 BROADWAY, NEW YORK, U. S. A.

SALES OFFICES—Bosto Chicago, Commercial National Bank Bldg. Pittsburgh, Frick Bldg. St. Louis, 516 No. Third St. Philadelphia, 21st St. John, Toronto, Calgary, Winnipeg and Vancouver. Agents for California, Nevada and St., Los Angeles, Cal. Italy, Ing. Ercole Vaghi, Milan. Germany, F. G.

Straight Steam-Hammer Argument

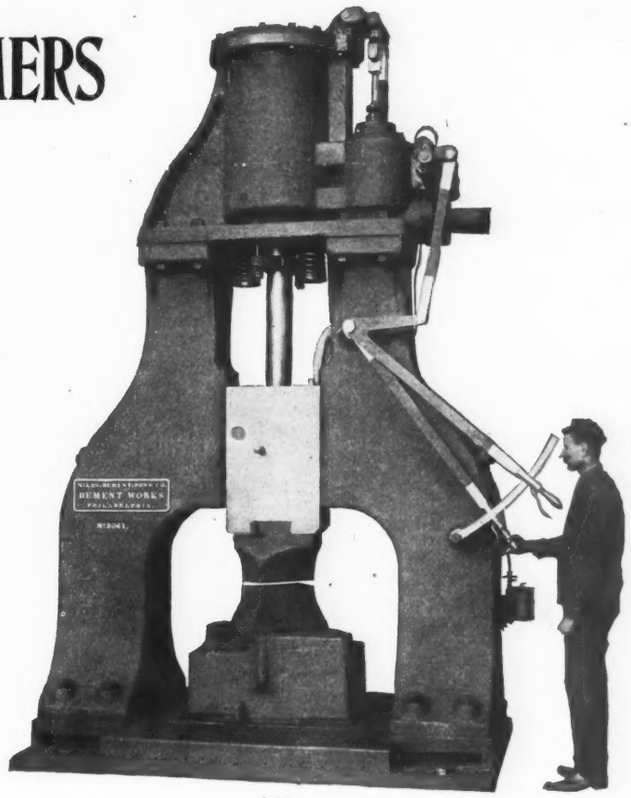
THE BEMENT HAMMERS

Any Man Can Operate Them

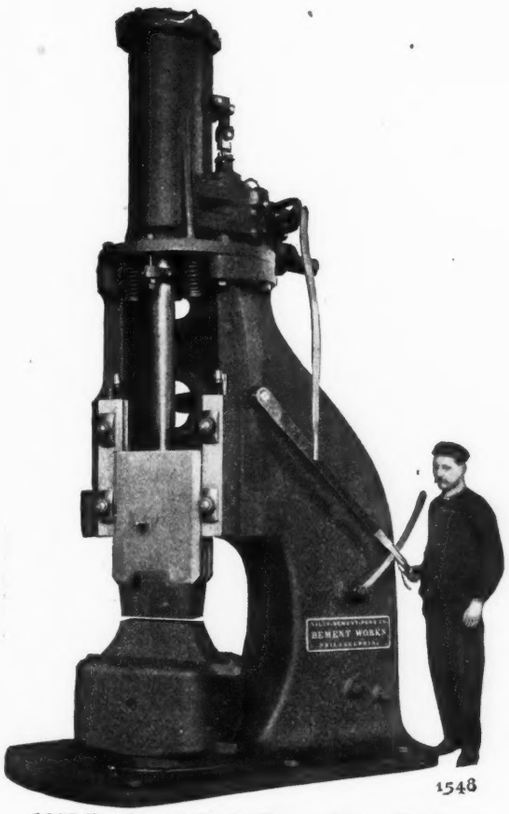
Simplicity
In Construction and Operation.

Reliability
In Action and Construction.

Economy
In Maintenance and Steam Consumption.



1500
1600-lb. Bement Tilting Hammer



1548
1100-lb. Bement Single Frame Steam-Hammer

If a shop does any kind of forging, a steam-hammer should be employed, not only from the economy point of view, or increased production, but also for convenience. A steam-hammer is always ready, while without a hammer valuable time is wasted in rounding up the laborers to swing a sledge.

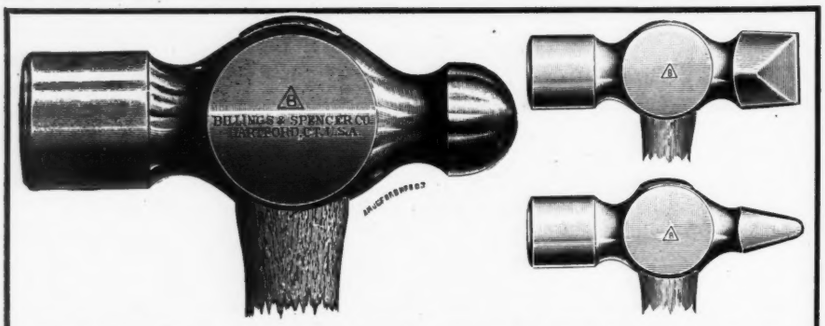
Numerous operations that are now sledged by 3 or 4 men and numerous "heats" in half a day, can be most advantageously worked with a steam-hammer, and the time required figured in minutes instead of hours.

Get the Catalog, "Bement Hammers."

POND COMPANY
LONDON, 25 VICTORIA ST., S. W.

Bement Hammers, Hydraulic Machinery

and Callowhill Sts Birmingham, Ala., Brown-Marx Bldg. Detroit, Mich., Majestic Bldg. Agents for Canada, The Canadian Fairbanks Co., Ltd.. Montreal
Arizona, Harron, Rickard & McCone, 461 Market St., San Francisco, and 164-168 N. Los Angeles
Kretschmer & Co., Frankfort, a/M. Japan, F. W. Horne, 70-C Yokohama.



WE CLAIM for these hammers (**B. & S. Round Pattern**) the highest degree of perfection attainable as to material, design, temper and finish. Every detail has been carefully considered including the size, shape and "hang" of the handles. For tool makers, die sinkers and high-grade work they cannot be excelled. Sizes ¼ lb. to 1½ lbs. as described in our general catalog. We also make another grade of hammers for general machinists' work.

Write for our Catalog.

THE BILLINGS & SPENCER CO., Hartford, Conn.

FEEDS READILY SET

IN THE KNECHT PLANER

ACCURATE

FEED RANGE

FROM 1-64" TO 3-4"

INCREASING BY 1-64"

THE KNECHT PLANER CO.

CINCINNATI, O.

PERFECT

DOUBLE TANGS

DOUBLE the Grip, and

DOUBLE the life of the shank

Circular 17-M tells why.

The Cleveland Twist Drill Co.

NEW YORK CLEVELAND, O. CHICAGO

See page 31.

COES WRENCHES

Steel Always Reliable

WRITE

COES WRENCH CO., - Worcester, Mass.

Or, J. H. Graham & Co., J. C. McCarty & Co., New York.

Automatic and Special Machinery

of all kinds designed and built. Inventions perfected. Builders of Variable Speed Iron Planers. Correspondence Solicited.

ENGINEERS AND MACHINISTS.

***The* W. A. Wilson Machine Co.**

ROCHESTER, NEW YORK.

A Head a Second—

All Perfect—No Noise

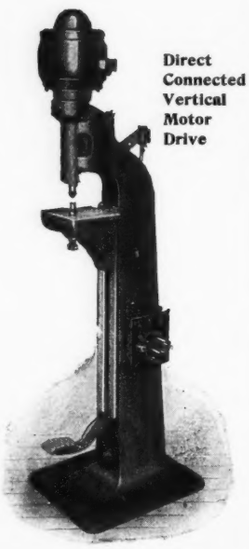
In reality the speed of

The Grant Rotary Rivet Spinning Machine

is only limited to the operator's ability. It spins a perfect head on all rivets up to ⅜", soft brass to hardened steel, without noise or striking a blow.

One customer writes: "The Machine has proven a profitable investment. Although used exclusively for heavy duty on steel it turns out the work in a uniform and quick manner. The simple but adequate provision for changing jobs permits a **large variety of work** to be taken care of without the attention of skilled workmen."

What the Grant is doing for others it will do for you. Give us a chance to demonstrate more fully. **Catalogue?**

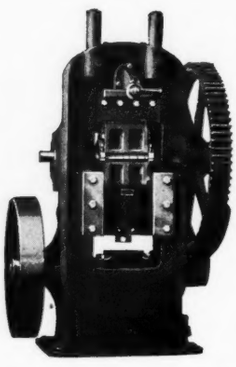


Direct Connected Vertical Motor Drive

The Grant Mfg. and Machine Co.

80 Silliman Avenue, BRIDGEPORT, CONN.

440 TON



K. J. PRESS

All joint pins are tool steel accurately ground after hardening to fit the bronze surfaces of the toggles.

PRESSES OF THE FINEST WORKMANSHIP

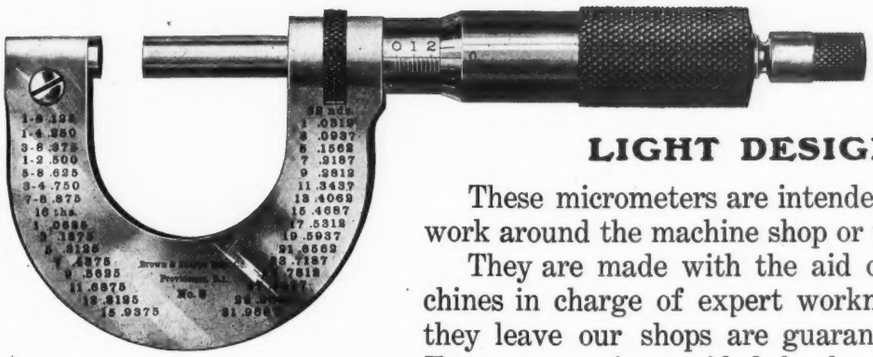
The Waterbury Farrel Foundry & Machine Co.

Waterbury, Conn., U. S. A.

Cleveland Office: 1012 Williamson Bldg.
Philadelphia Office: Real Estate Trust Bldg.

Their measurements are standard—a reputation earned because of the accuracy of their workmanship

B. & S. Micrometer Calipers



LIGHT DESIGN

These micrometers are intended for ordinary work around the machine shop or tool room.

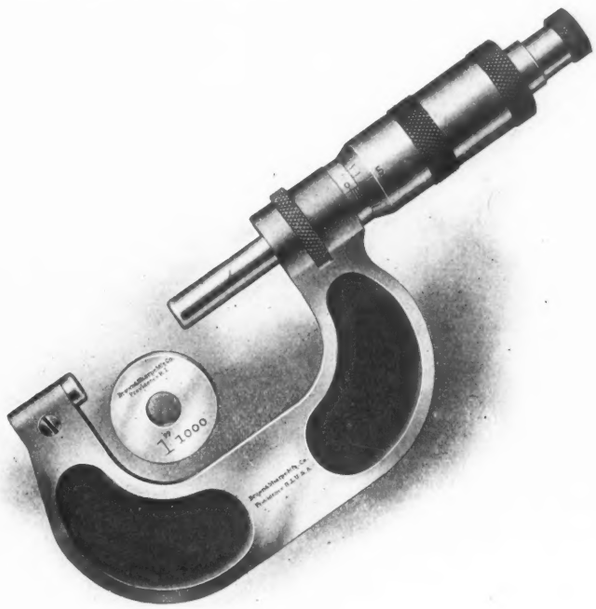
They are made with the aid of special machines in charge of expert workmen and when they leave our shops are guaranteed accurate. Every means is provided for keeping them accurate after they are in use, all of the bearing parts and measuring surfaces being hardened to prevent wear and, in addition, means are provided to compensate for wear.

The micrometers are provided with clamp rings to firmly hold the spindle and preserve the setting. Ratchet stops can be furnished when desired.

HEAVY DESIGN

The micrometers of heavy design are distinctively new and are intended for use wherever an accurate instrument is desired for constant and severe usage. They are particularly recommended for grinding rooms where an instrument is exposed to water, grit and the necessity of taking frequent measurements with the clamp ring set.

The frame is of heavy I section and the spindle and threaded portion are of larger diameter than usual. These features permit of greater stiffness and longer life.



Write us for further particulars and prices.

Brown & Sharpe Mfg. Co.

Providence, R. I., U. S. A.

NEW BOOKS AND PAMPHLETS

NATIONAL METAL TRADES ASSOCIATION PROCEEDINGS. 12TH ANNUAL CONVENTION, NEW YORK, APRIL 13-14. Published by the Association. Robert Wuest, Commissioner, 605 New England Building, Cleveland, Ohio.

The proceedings include the following technical papers: "The Fitchburg Plan of Industrial Education," by W. B. Hunter; "Growth of the Cooperative System," by Professor Herman Schneider; "A Plea for Continuation Schools," by Dr. Frank B. Dyer; "The Compensation of Workmen," by H. L. Gantt; "Cincinnati's Continuation Schools," by J. Howard Renshaw; "Employers Liability Insurance," by Miles M. Dawson; "Modern Methods of Shop Management," by Frederick A. Waldron; "Labor Bureaus," by Joseph A. Holland; "Industrial Education," by Prof. Dexter S. Kimball. The proceedings will be found of much interest by all concerned with the problems of industrial education.

WORK, WAGES AND PROFITS. By H. L. Gantt. 194 pages, 4¾ x 7¼ inches. Published by the *Engineering Magazine*, New York. Price $2.

This work is a re-issue in book form of a series of articles, "Compensation of Workmen and Efficiency of Operation," published in the *Engineering Magazine*, to which have been added three of Mr. Gantt's most important preceding contributions, revised and brought up to date. The work, as a whole, is a complete statement of Mr. Gantt's ideas on methods of works management and compensating workmen. The contents by chapters are: The application of scientific methods to the labor problem, utilization of labor, compensation of workmen, day work, piece work, task work with bonus, training workmen in habits of industry and cooperation, fixing habits of industry, profits and their influence on the cost of living. The work is one that can be read with interest by those not directly connected with the problems of manufacture.

TESTS OF TIMBER BEAMS. By Arthur N. Talbot. Bulletin No. 41. 77 pages, 6 x 9 inches. Published by the University of Illinois Engineering Experiment Station, Urbana, Ill.

The investigations were undertaken to obtain information on the structural properties of full-sized timber beams such as are used in bridge practice, but of course, the results are applicable to timbers wherever employed in all forms for building construction. The tests include 112 full-sized stringers and several hundred smaller test pieces cut from large beams. The woods tested were long-leaf pine, short-leaf pine and Douglas fir. The fiber stresses developed in beams not shearing horizontally is generally low, averaging, on untreated timber tested, from 3690 in Old Douglas fir to 5300 pounds per square inch in the long-leaf pine. The results disclose the very interesting fact that timbers having knots and cross grains are generally less stiff than clear timber. From this fact it is obvious that when strong sticks and defective sticks are placed side by side in a structure, the weaker stick usually takes less than its share of the load.

A PATHFINDER—DISCOVERY, INVENTION AND INDUSTRY: Subject, Edward G. Acheson. 143 pages, 6 x 9 inches. Published by the Press Scrap Book, 209 Broadway, New York.

We are indebted to the International Acheson Graphite Co., Niagara Falls, N. Y., for this beautiful example of bookmaking, of which company Dr. Acheson is the president. The world knows vaguely that Dr. Acheson is a renowned discoverer and inventor, but few know just what remarkable things he has accomplished. Originally written for the benefit of his family and friends, it has been secured from Dr. Acheson and published to give the youth and young men of the country a life story that is an incentive to ambition. It records his early struggles, his experience with Edison at Menlo Park, travels in Europe, discovery and development of carborundum, graphite, Egyptianized clay, direct reduction of aluminum and silicon, production of siloxicon, aquadag and oildag. Dr. Acheson has read many important and valuable papers before scientific societies and has had many honors conferred on him. The work is one that should interest all who are attracted to advanced and original scientific work.

ENGINEERING CHEMISTRY. By Thomas B. Stillman. 755 pages, 6 x 9 inches, 174 illustrations. Published by the Chemical Publishing Co., Easton, Pa. Price $5.

This work, which now appears in the fourth edition, is a manual of quantitative chemical analysis for the use of students, chemists, and engineers. Much of it has been re-written by the author, who was formerly professor of engineering chemistry at Stevens Institute of Technology. It describes the proximate analysis of coal and coke, analysis of limestone, iron ores, manganese ores, blast furnace slag, copper, lead and zinc, boiler waters, chimney gases, etc. It also describes the construction and use of the Uehling gas compositemeter and Junker's gas calorimeter. A chapter is devoted to practical photometry. A partial list of contents will give an idea of the scope of the work: Manufacture of water gas, composition of natural gas, natural gas under steam boilers, liquid fuel, the blast furnace as a power plant, method of the United States Steel Corporation for commercial sampling of iron ores, foundry chemistry, carbon compounds of iron, analysis of tin plate, analysis of clay, fire sand, composition of natural cement, the chemical and physical examination of Portland cement, testing of brick, saline efflorescence of brick, asphalt, soap analysis, examination of lubricating oil, oils used for illumination, paint analysis, etc.

WORK-ACCIDENTS AND THE LAW. By Crystal Eastman, edited by Paul Underwood Kellogg. 345 pages, 6 x 9 inches. Illustrated. Published by the Charities Publication Committee, New York, under the Russell Sage Foundation. Price $1.50, postage 15 cents extra.

This remarkable and absorbingly interesting work treats of the industrial problem in its relation to the laboring classes, without gloves. It is a terrible indictment of conditions with some phase of which most of us are familiar, but of which very few realize the monstrous proportions in the country as a whole. One reads with pity, horror and indignation of accidents that have crippled men, bereaved wives and parents, and thrown dependent children upon charity which could have been prevented if the simplest precautions had been observed. "Man's inhumanity to man makes countless thousands mourn" takes on a new significance after having read the chapters on the railroaders and steel workers. On the other hand, a large proportion of work-accidents are the result of individual carelessness or deliberate disobedience to rules. A great deal of educational work has to be done with employes to bring about a general sense of the need of always being careful in the use of machinery, the piling and handling of material, etc. Space will not permit giving this great work the thorough review that it merits. It should be in the hands of all manufacturers and others employing labor, especially in hazardous occupations. It treats of the causes of work-accidents, economic cost of work-accidents and employers' liability. Those who believe that every large industry should bear the burden of caring for its employes killed, maimed or injured and their families, will read this book with heartfelt approval and be moved, we hope, to promote the movement to secure such state legislation as shall be just and equitable to all concerned.

CATALOGUES AND CIRCULARS

CLINTON EDWARDS, 27 East 22nd St., New York. Bulletin on industrial engineering.

BROWN INSTRUMENT CO., 311 Walnut St., Philadelphia, Pa. Circular No. 5 of Brown thermometers.

ASSOCIATION OF AUTOMOBILE ENGINEERS, 1451 Broadway, New York. List of members of the association.

INGERSOLL-RAND CO., 11 Broadway, New York. Bulletin No. 8108 on "Crown" bench and floor sand rammers.

AMERICAN BLOWER CO., Detroit, Mich. Bulletins Nos. 267 and 273 on "Detroit" steam traps and the "A B C" heater.

HILL CLUTCH CO., Cleveland, Ohio. Catalogue No. 8 on friction clutches for general power transmission purposes.

SPRAGUE ELECTRIC CO., 527-531 West 34th St., New York. Bulletin No. 600 on single-phase and polyphase induction motors.

HAMMACHER SCHLEMMER & CO., 4th Ave. and 13th St., New York. Catalogue 400 on hand screws and clamps of all kinds, comprising practically everything in this line.

T. R. ALMOND MFG. CO., Ashburnham, Mass. Circular of Almond right-angle coupling for power transmission, built in four sizes, 5, 10, 20 and 40 horsepower, respectively.

ROCKFORD LATHE & DRILL CO., Rockford, Ill. Descriptive circular of 13-inch floor drill having a drilling capacity up to ¾-inch hole and to the center of a 13-inch circle.

C. W. HUNT CO., West New Brighton, N. Y. General catalogue 102 of coal-handling and hoisting machinery, conveyors, industrial railways, electric locomotives, steam hoists, etc.

RUSSELL JENNINGS MFG. CO., Port Chester, N. Y., has published an illustrated booklet entitled: "How to Sharpen Auger Bits, and How to Care for Them." Copies will be sent free on request.

CUTLER-HAMMER MFG. CO., Milwaukee, Wis. Bulletin of 48 pages entitled "Battery Charging Rheostats," which illustrates and describes the company's entire line of battery charging rheostats.

CINCINNATI IRON & STEEL CO., Cincinnati, Ohio. Booklet entitled "Pointers on Machinery." The company carries a complete line of machinery for automobile, carriage, wagon, sheet-metal and structural shops.

INGERSOLL-RAND CO., 11 Broadway, New York. Bulletin No. 8803 on "Imperial" high-duty pneumatic hammers, comprising scaling hammers, chipping hammers, riveting hammers, chisel and rivet shanks, duplicate parts, etc.

HUTHER BROS. SAW MFG. CO., INC., Rochester, N. Y. Catalogue of patent dado heads, milling saws, box board matcher cutters, lock corner cutters, concave saws, saw fitting machinery and all kinds of special grooving saws for wood working.

MIAMI VALLEY MACHINE TOOL CO., Dayton, Ohio. Descriptive circular of the Miami Valley No. 1 universal tool and cutter grinder having a capacity of 16 inches between centers and swing of 8 inches. See description in MACHINERY, March, 1910.

INGERSOLL MILLING MACHINE CO., Rockford, Ill. Bulletins Nos. 18 C and 19 C, illustrating and describing the design and application of fixed rail automobile multiple-spindle milling machine designed especially for builders of automobile gasoline motors.

FIDELITY & CASUALTY CO., 92 Liberty St., New York. Rules for operating low-pressure steam pumps, and rules for operating high-pressure steam power boilers. These rules should be placed in the hands of engineers and firemen of steam plants generally.

RICHARD DUDGEON, 24-26 Columbia St., New York. Booklets 9 and 11 on the Dudgeon universal hydraulic jack, printed in Spanish and French, respectively. The pamphlets illustrate the construction of the Dudgeon hydraulic jacks and contain directions for use. Copies are sent free on request.

NEW YORK BELTING & PACKING CO., 91-93 Chambers St., N. Y. Engineers' catalogue showing high-grade packings for all conditions of service, comprising piston-rod packings, valve-stem packings, high-pressure steam packings, waterproof packings, hydraulic packings, sheet packings, gaskets, pump valves, pump diaphragms, valve disks, asbestos wicks, etc.

BRISTOL CO., Waterbury, Conn. Illustrated index of Bristol recording instruments for pressure, temperature and electricity, and Bristol electric pyrometers for high temperatures. This attractive pamphlet should interest all shop managers, central station engineers, and others desiring accurate and reliable records of temperatures, machine operations, pressures, etc.

AMERICAN CHAMBER OF COMMERCE, 3 Rue Scribe, Paris, France, has issued bulletin No. 82 on the Franco-American tariff agreement which contains a synopsis of the new French tariff on American products. Manufacturers, exporters, and others doing business with France will find this synopsis of value. It is printed in French and English, in parallel columns, on opposite pages.

INTERNATIONAL ENGINEERING CO., 1779 Broadway, New York. Price list of Lemoine springs for motor cars. The price list includes useful data for engineers and designers such as load, length, width and camber for front, semi-elliptic rear and three-fourths-elliptic springs; also tables showing distances springs may be deflected without taking permanent set, the material being mangano-silicon, premiere qualite steel, qualite courante steel, etc.

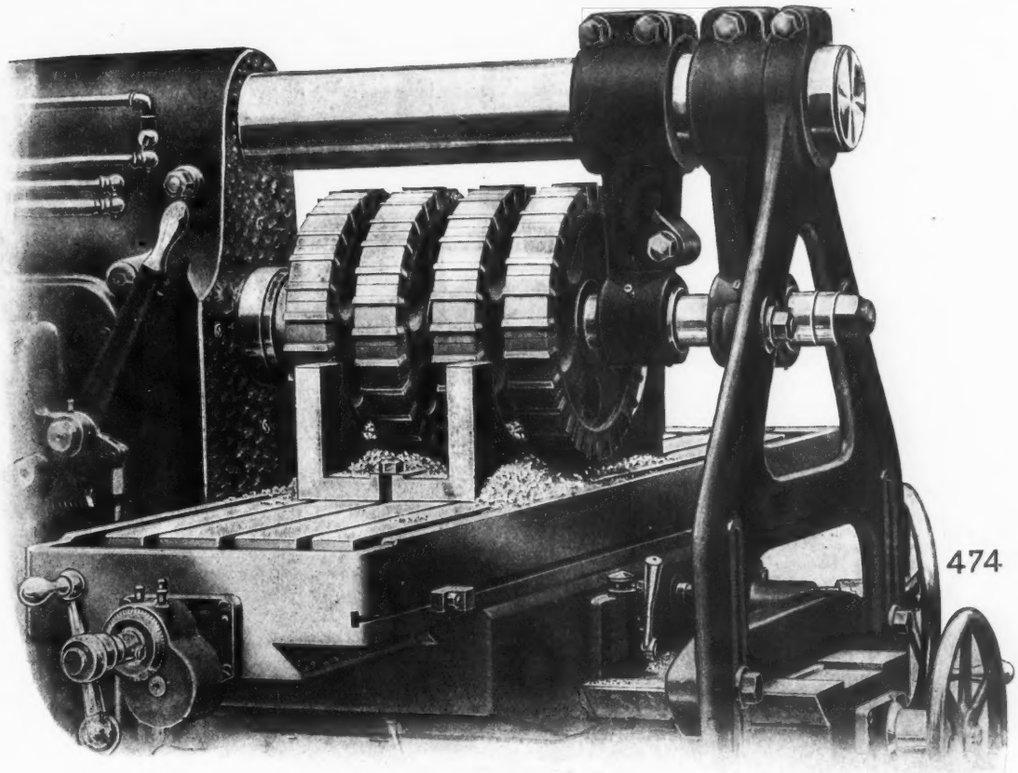
ANDERSON FORGE & MACHINE CO., Detroit, Mich. Folder briefly describing the company's new drop forge plant which occupies thirteen acres located on Jefferson Ave. The folder illustrates a 7500-pound steam drop-hammer that will be installed. The hammer takes a die weighing five tons, and delivers a blow of 12,000,000 foot-pounds. The equipment of the plant will be of the most advanced type. Oil will be used as fuel throughout. The plant is expected to be ready for occupancy September 1.

INGERSOLL-RAND CO., 11 Broadway, New York. Pamphlet 9001 on the Davis "Calyx Diamondless" core drill. One form of the Davis "Calyx" drill employs a cutter of the hollow mill variety, the teeth being made of steel. The cutter does not cut the rock, but chips it away, which is doubtless the secret of its ability to stand up in hard rock. Another form of cutter employs chilled shot. The advantages of the "diamondless" drill, of course, are lessened first cost and reduced cost of up-keep.

AETNA LIFE INSURANCE CO., Hartford, Conn. Pamphlet on the care and operation of elevators, published with a view of preventing accidents. The purpose of the pamphlet is to call attention to certain matters in the care and operation of elevators which should never be overlooked or neglected if accidents are to be prevented. It treats of general considerations affecting elevator installation, investigation, the attitude of the owner, agent, the engineer, operator, passenger, safety of equipment, careful operation, useful information, elevator warning signs, etc. The pamphlet will be sent free to those interested.

BROWN INSTRUMENT CO., 311 Walnut St., Philadelphia, Pa. Catalogue No. 3 containing 48 pages on electric pyrometers. The Brown pyrometers are made with nickel-chrome alloy couples for use at temperatures up to 2200 degrees F. and for intermittent use up to 2400 degrees F. For temperatures up to 3000 degrees F. they are supplied with platinum-rhodium couples and horizontal indicators. Electric recording pyrometers and methods of installing the various parts of pyrometers in furnaces, etc., are shown. The catalogue also illustrates the Brown radiation pyrometers for measuring the highest temperatures. This instrument is similar to a telescope with a tripod, the

Cincinnati Productiveness



The No. 4 Plain High Power Cincinnati Miller

direct connected to a 10 H. P. variable speed motor, milling grey iron castings.

The cutters are 13½″ diameter, high speed steel, run 13½ rev., taking a cut ⅛″ deep across eight surfaces having a total width of 23″, at a feed of 4″ per minute. This amounts to 11½ cubic inches of iron removed per minute, and even this is not the limit of the capacity of the machine, but is all that the cutters will stand.

This sort of work puts heavy strains on the table and its feed mechanism. Our design of these parts is based on our long experience and definite knowledge of the work they have to do.

The feed screws are very large and have quick pitch threads.

Torsional vibration is entirely eliminated because **the drive to the screw is always close to the nut;** never through the length of the screw.

The saddle has wide bearings and supports the full width of the table, avoiding overhang.

These are some of the exclusive Cincinnati features which make rapid production possible.

Ask us for Catalog.

The Cincinnati Milling Machine Co.

CINCINNATI, OHIO, U. S. A.

CONTENTS FOR AUGUST

The first column of page numbers applies to the Engineering and Railway Editions; the Second to the Shop Edition

THE ELLIS ADDING TYPEWRITER. Ralph E. Flanders. 971
MULTIPLE CUTTER TOOLS. W. S. Giele..... 979
ECCENTRICALLY LOADED BOLT AND RIVET GROUPS. M. Terry..... 980
TO DIVIDE A TRAPEZOID INTO EQUAL AREAS. M. F. Jackson 981
REPAIRING AND IMPREGNATING COILS. Ralph W. Davis 982
COMPRESSED AIR RECEIVERS. G. J. MacFadden..... 983
DETERMINING COMPARATIVE VALUES OF LEATHER BELTING. 984
DONKIN'S DIVIDING ENGINE—EARLY MACHINE TOOLS. W. S. Davenport..... 985
NEW FACTORY OF THE FRANK MOSSBERG CO. Chester L. Lucas..... 987 667
HOW A MACHINE SHOP SYSTEM WAS IMPROVED. M. H. Westbrook. 992 672
MAKING OPEN-SIDE PLANERS. Ethan Viall..... 993 673
PERTINENT POINTS ON JIG AND FIXTURE DESIGN. C. Nosrac..... 994 674
DESIGNING SCREW MACHINE TOOLS AND CAMS. Douglas T. Hamilton..... 996 676
LOCATING HIDDEN BOLT HOLES. H. E. Wood.....1001 681
EDITORIAL. 1002 682
MACHINING ACCURATE QUICK-PITCH SCREWS AND NUTS. Francis J. Bostock.....1004
SPECIAL KEY-SLOT MILLING MACHINE.....1005
LABOR CONDITIONS IN AMERICAN AND GERMAN MACHINE SHOPS AND FOUNDRIES. W. H. Dooley....1005
BELL FOUNDING IN OLD FRANCE. Joseph G. Horner..1007
HIGH PRESSURE CYLINDER DIAMETERS FOR AIR COMPRESSORS. J. William Jones.....1009
THE CONVERSION OF COMPOUND ENGINEERING UNITS. Julian C. Smallwood.....1010
THE EXPERIENCES OF A YOUNG TOOLMAKER. T. Covey 1011 683
MACHINE SHOP PRACTICE—KEY FITTING.....1013 685
MACHINE WORK IN THE OIL COUNTRY—MAKING "JOINTS." 1014 686
SOME KINKS FOR PUNCH AND DIE WORK.....1017 689
MAKING GEAR CUTTERS FOR A JOBBING SHOP. Jack Finlay. 1019 691
HEAT TREATMENT OF STEEL. Charles Weslow.....1019 691
PRESS ATTACHMENT FOR A VISE. W. S. Leonard....1020 692
SIMPLE METHOD OF MAKING A DRILL JIG. D. O. Barrett. 1020 692
PUNCH AND DIE FOR PIERCING ANGULAR STOCK. Charles Weslow.....1020 692
CONDENSED PRICE LEAF FOR MACHINERY HOUSES. W. B. Patterson. 1021 693
ATTACHMENT FOR ROUNDING LINK ENDS. Donald A Hampson.....1021 693
FLOATING REAMER FOR INSURING STRAIGHT HOLES. John Brandle.....1021 693
A SPRING VISE-CLAMP. Fred Horner.....1022 694
HARDENING HIGH-SPEED STEEL. W. C. Betz.....1022 694
AUXILIARY SCALES ON THE TRIANGLE. Julian C. Smallwood. 1022 694
MACHINE ASSEMBLING HAMMERS. L. H. Georger....1022 694
BUILT-UP REVERSIBLE-SECTION BENDING DIE.....1023 695
PRINTS WITH BLUE LINES ON WHITE GROUND. Robert Grimshaw. 1023 695
CALIPERING OVER FLANGES. Fred G. Kenyon.....1024 696
CALIPERING OVER FLANGES. James Dangerfield.....1024 696
BOLLINCKX'S SCRAP-BOOK. Robert Grimshaw.....1024 696
FIXTURE FOR HOLDING SHAFT WHEN KEYSEATING. Arthur Z. Wolgamot.....1024 696
IRREGULAR SPACING OF THE CUTTING EDGES OF REAMERS. A. Nielsen.....1024 696
IMPROVED HYDRAULIC CYLINDER LINER. Benjamin Brownstein. 1025 697
CENTER INDICATOR FOR THE BENCH LATHE. Gustave Remacle, Jr.....1025 697
SHOP KINKS.....1026 698
NEW MACHINERY AND TOOLS.....1027 699
MANUFACTURING THE SIBLEY HIGH-SPEED DRILL PRESS 1040 712

part corresponding to the eye-piece in the ordinary telescope being directed to the flame whose temperature is to be measured.

ASSOCIATION OF AUTOMOBILE ENGINEERS, 1451 Broadway, New York, has issued a list of material specifications, published under the direction of Mr. Henry Souther, metallurgist, with complete instructions on the method of purchasing, inspecting and handling materials used in motor car construction. The materials include low- and high-carbon steel, carbon spring steel, screw stock and high-carbon nickel steel, chrome-nickel steel, chrome vanadium steel, chrome vanadium spring steel, silicon spring steel, alloy steel, steel castings, gray iron castings, malleable iron, babbitt metals, white brass, phosphor-bronze bearing metal, aluminum alloys and automobile engine lubricating oil. A great deal of attention is given to the heat treatment of steel. The work will be issued only to the members of the society.

TRADE NOTES

GILBERT & BARKER MFG. CO., Springfield. Mass., manufacturer of gas machines, and gas and oil furnaces, is building an addition to its factory.

WAGNER ELECTRIC MFG. CO., St. Louis, Mo., has changed the location of its Denver office from the Ideal Building to the Gas and Electric Building.

BURROUGHS ADDING MACHINE CO., Detroit, Mich., is building a four-story concrete-fenestra building that will add 80,000 square feet to its floor space.

WINKLEY CO., Detroit, Mich., has more than doubled its capacity by the building of a large one-story concrete and steel addition in which the installation of machinery has been practically completed.

UNION MACHINE CO., INC., 164 University Ave., St. Paul, Minn., has been appointed general manufacturing and selling agent for the products of the Plunger Plastic Packing Co., Inc., St. Paul, Minn.

BRIGHTWOOD MOTOR MFG. CO., Springfield, Mass., has bought the plant and equipment of the Bailey Automobile Co., and is adding considerable machinery for the manufacture of a new line of automobiles.

C. W. HUNT CO., West New Brighton, New York, has made arrangements with the San Francisco Bridge Co., San Francisco, Cal., to handle the company's Pacific coast business in coal handling, conveying, and hoisting machinery.

MIAMI VALLEY MACHINE TOOL CO., Dayton, Ohio, has recently completed an addition to its building, greatly increasing its floor space, for assembling purposes. The addition will enable the company to considerably increase its output of engine lathes, universal cutter and plain tool grinders and drills.

LAPOINTE MACHINE TOOL CO., Hudson, Mass., gave its employes their first annual outing Saturday, June 25, at Treaty Elm Grove, Stow, Mass. About 150 attended. Sports were provided and prizes given to the successful competitors. Music was furnished by the Hudson Band. The event was a great success.

BROWN & SHARPE MFG. CO., Providence, R. I., announces that its works will be closed from August 5 to 22 for the annual vacation. During that period the offices will be opened as usual and orders for machine tools, machinists' tools and measuring tools will receive attention as at other periods of the year.

INVINCIBLE ELECTRIC BANK PROTECTION CO., Munroe, Wis., manufacturer of double steel electrified vaults, linings and complete electric alarm systems, has added to its output a line of improved safe-deposit boxes, filing cases, roller shelving, omnibuses, desks, tables, etc. The capacity of the company has been more than doubled during the last three months.

BAUSH MACHINE TOOL CO., 200 Wason Ave., Springfield, Mass., has begun the publication of a house-organ entitled *The Driller*. The second number is attractively printed in black and red and, besides the advertising and argument for the Baush multiple-spindle drill, contains interesting shop notes and miscellany. It will be sent on request to those interested.

CINCINNATI PLANER CO., Cincinnati, Ohio, reports an improvement in foreign business during the month of June. The company booked orders for planers from Siberia, Germany, Holland, Italy, Mexico, Cuba, South America and Canada. It also booked some large orders from prominent concerns in the United States, and the prospects for a big year's business are good.

BANTAM ANTI-FRICTION CO., Bantam, Conn., through its president, Mr. W. S. Rogers, who is spending the summer in Europe, has secured sole representation in America for the well-known steel balls made by Heller Bros., Marienthal, Germany, and DKF ball bearings made in Leipsig. It is the intention of the company to open branch offices in Philadelphia and Detroit in the Autumn.

ST. LOUIS STEEL FOUNDRY, St. Louis, Mo., owned and operated by Curtis & Co. Mfg. Co., has increased its capacity about 100 per cent as a result of the success the company has made in the manufacture of manganese steel crossings, frogs, switches, etc., for steam and electric roads, and miscellaneous manganese steel castings. The addition has been completed and additional crane and grinding equipment has been installed.

T. R. ALMOND MFG. CO., Ashburnham, Mass., is distributing copies of tests recently made at the Orswell Mills, Fitchburg, Mass., showing the horsepower required to drive spinning mules. The tests demonstrate the desirability of using flywheels of about 30 inches diameter, weighing about 600 pounds, to reduce the power fluctuations, and it is expected that a No. 3 Almond right-angle transmission will drive two mules satisfactorily.

ELECTRIC WELDING PRODUCTS CO., Cleveland, Ohio, has moved into its new factory addition 94 x 100 feet, three stories high. New machinery has been installed and offices have been fitted out on the second floor of the new building. The number of men now employed is about 350. The company solicits business particularly from automobile and parts manufacturers, manufacturers of machinery, electric apparatus, and stationary engines.

INTERNATIONAL ACHESON GRAPHITE CO., Niagara Falls, N. Y., will erect a large addition to its works on the lands of the Niagara Falls Power Co. in that city. The addition will be a furnace room having a capacity for ten or twelve new furnaces. The building will be of brick and steel construction. The additional furnaces will largely increase the output of graphite which is used in the manufacture of electrodes, paint pigment, lead pencils, electroplaters, molding and polishing leads, lubricants, etc.

ACHESON OILDAG CO., Niagara Falls, N. Y., has purchased a factory site of thirty acres at Port Huron, Mich., where it will erect a building for the manufacture of oildag. The price of oildag has been reduced to approximately 60 per cent of that recently quoted, which brings it down to a price, when bought in quantities, considerably less per gallon than that of the oil with which it is mixed. It is claimed that the presence of deflocculated graphite in the oil makes each gallon equal to from two to four gallons of plain oil.

WAGNER ELECTRIC MFG. CO., St. Louis, Mo., has removed its Charlotte, N. C., office to the Woodward Building, Birmingham, Ala., where it will be in charge of Mr. J. F. Jones. The Birmingham office will serve that part of Tennessee east of the Tennessee River and all of the states of Mississippi, Alabama, Georgia and Florida. North and South Carolina, which have hitherto been handled from the Charlotte office, will now be served by the Philadelphia office, which is located in the Real Estate Trust Building, in charge of Mr. John Mustard.

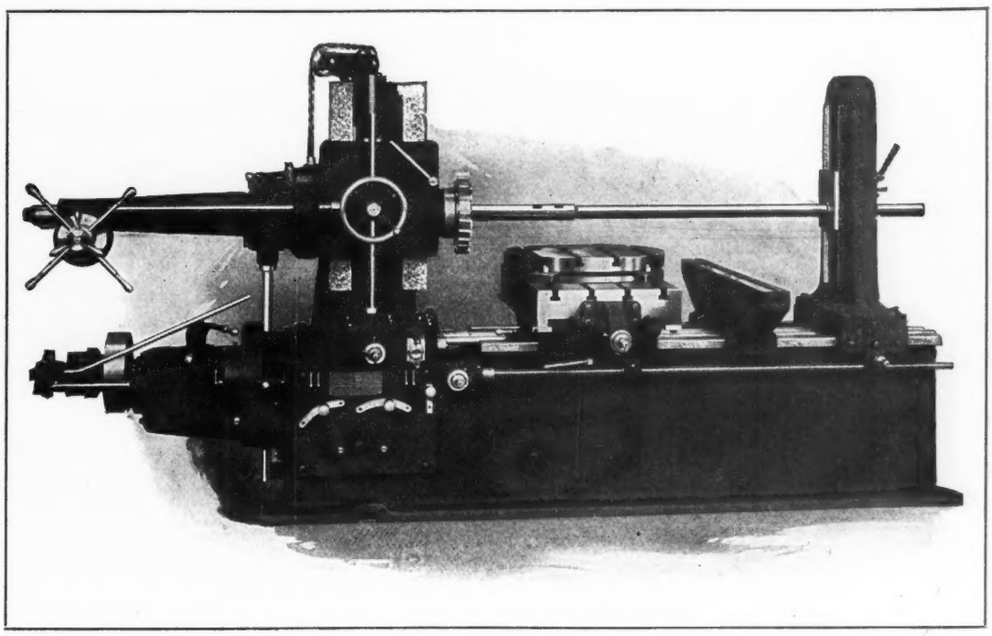
WAGNER ELECTRIC MFG. CO., St. Louis, Mo., has opened an office in the Woodward Building, Birmingham, Ala., which will be in charge of Mr. J. F. Jones. Mr. Jones, who is a Southerner, graduated from the Alabama Polytechnic Institute in 1901, when he entered the employ of the General Electric Co., working in its testing department, inspection department and finally becoming transformer salesman. In 1905 he became transformer sales engineer for the Fort Wayne Electric Works, and in 1909 joined the home office force of the Wagner Electric Mfg. Co.

TAFT-PEIRCE MFG. CO., Woonsocket, Mass., has opened an office at 1311 Majestic Building, Detroit, Mich., where competent mechanics will be located for the express purpose of looking after the company's interests in the Middle West. The increasing demand for prompt and high-grade service in the designing and construction of special tools

One of the secrets of the success of the

LUCAS (NOW AND ALWAYS OF CLEVELAND)

"PRECISION" BORING, DRILLING and MILLING MACHINE



is that it

CONSTANTLY IMPROVES

We believe that "Give to the world the best you have and the best shall come to you", and we are ALWAYS WORKING ALONG THAT LINE.

LUCAS MACHINE TOOL COMPANY

CLEVELAND, OHIO, U. S. A.

FOREIGN AGENTS: C. W. Burton, Griffiths & Co., London. Alfred H. Schutte, Cologne, Brussels, Liege, Paris, Milan, Bilbao, Barcelona. Schuchardt & Schutte, Berlin, Vienna, Stockholm, St. Petersburg, Copenhagen, Budapest. Overall, McCray, Ltd., Sydney, Australia. Andrews & George, Yokohama, Japan.

such as jigs, fixtures, gages, etc., has required the Western office. The company now has, in its Woonsocket plant, one of the most completely equipped tool-rooms in the country, with ample facilities for at least 250 workmen.

JOSEPH T. RYERSON & SON, Chicago, Ill., have removed their New York office to the seventh floor of the Hudson Terminal Building. The office will be maintained in connection with the machinery display rooms and warehouses immediately adjacent to the Jersey City terminal of the Hudson-Manhattan tunnel. A complete stock of boiler, structural and machine shop fittings and specialties, Morison corrugated furnaces, Glyco bearings, tool steel, metal-working specialties and shop supplies and equipment will be carried. The shipping facilities are unexcelled.

B. F. STURTEVANT CO., Hyde Park, Mass., manufacturer of fans, blowers, fuel economizers, and mechanical draft apparatus, held a salesman convention June 15-18. The company's branch office managers and principal salesmen from all over the country assembled at the works and general office of the company at Hyde Park, and spent four busy days in going over general business. The evenings were enlivened by banquets and other social features. The last day of the convention closed with a delightful sail down the harbor and an afternoon and evening at the Cohasset home of Mr. E. N. Foss, treasurer of the company.

KEUFFEL & ESSER CO., Hoboken, N. J., manufacturer of drawing materials and engineering supplies, celebrated the forty-third anniversary of the founding of the house Tuesday evening, July 19, by a banquet to its employes at Grand View Park, Jersey City Heights, N. J. Interest was added by the fact that four employes this year complete their twenty-fifth year of service with the company. Appropriate gifts were presented to them by the company and some very handsome testimonials were given them by their fellow workmen. Twelve employes, who have completed a quarter of a century of service with the company, occupied places of honor with the officers. The evening proved to be so great a success in cementing the interest of all concerned that the banquet no doubt will be made an annual institution.

AGNEW ELECTRIC WELDING CO., 868 Military Ave., Detroit, Mich., has issued a statement regarding its activities and business control. The control and management of the company recently changed hands. A party of Cleveland men, active in the management of the Electric Welding Products Co., Cleveland, Ohio, has bought out the Agnew interests. The officers of the company are: C. E. Thompson, president; J. A. Krider, vice-president; R. K. Loofburrow, secretary and treasurer. The company will immediately add to its facilities, and expects to move from 868 Military Ave. to a better location in Detroit. Application has been made to change the name of the company to the Michigan Electric Welding Co. The company makes a specialty of welding automobile work such as the forging of rod yoke ends assemblings complete, drag links, fore-and-aft connections, propeller shafts, and in short the welding of any sort of forgings and parts that can be successfully welded to rods, shafts, tubes, etc.

MISCELLANEOUS

Advertisements in this column, 25 cents a line, ten words to a line. The money should be sent with the order. Answers addressed to our care will be forwarded. Original letters of recommendation should not be enclosed to unknown correspondents.

AGENTS IN EVERY SHOP WANTED to sell my sliding Calipers. Liberal commission. ERNST G. SMITH, Columbia, Pa.

AGENTS wanted in every works in Great Britain where draftsmen, machinists and tool-makers are employed, to represent MACHINERY and take orders for MACHINERY's remarkably successful Reference Books. Special offers in force in Great Britain for a limited time only, give a choice of 60 Reference Books sold at a shilling per copy, and a subscription for MACHINERY, cash or *credit*. No charge is made for credit. We supply sample copies and advertising matter describing the books in detail for distribution in Engineering Works. Write us for full information. WM. DAWSON & SONS, LTD., Cannon House, Bream's Bldgs., London, E. C.

A WELL EQUIPPED MACHINE SHOP within thirty (30) miles from New York solicits orders for all kinds of machine work. Send inquiries: THE BRUNSWICK REFRIGERATING CO., New Brunswick, N. J.

DRAFTSMEN AND MACHINISTS.—American and foreign patents secured promptly; reliable researches made on patentability or validity; twenty years practice; registered; responsible references. EDWIN GUTHRIE, Corcoran Building, Washington, D. C.

DRAWINGS, TRACINGS, ETC., MADE.—Prices reasonable. Box 1302, Orange, Mass.

EXPERT MECHANIC wishes position as General Foreman in Grinding and Polishing department after August 15th. Is up-to-date, possesses good executive ability and has had wide experience in handling help. Experienced on gun work and general hardware of all kinds. Good systematizer, and can turn out high grade work at minimum cost. Excellent references. Address box 307, care MACHINERY, 49 Lafayette St., New York.

FORMULAS AND TABLES FOR SHOP AND DRAFTING ROOM is No. 35 in MACHINERY's Reference Series, and for practical use in mechanical work is undoubtedly the most widely technical useful book published in years. Send for free pamphlet with new offers. Address MACHINERY, 49 Lafayette St., New York.

FOR SALE.—2 Gridley Single Spindle Automatics; 1 Woods No. 188 Automatic Cutting-off Saw. SULLIVAN MCHY. CO., Claremont, N. H.

FOR SALE.—One Warner & Swasey 2-spindle Valve Milling Machine with stem squaring attachment, used about thirty days. SWEET & DOYLE FOUNDRY & MACHINE CO., Green Island, N. Y.

FOR LEASE—A FOUNDRY thoroughly equipped for general machinery, soil pipe, iron and bronze work. Complete with many patterns, flasks, two cupolas and motors, brass furnaces, etc. Located on the railroad tracks in one of the best industrial cities of the Southeast. Lease $2000.00 per year. A splendid opportunity for the right man. Address box 300, care MACHINERY, 49 Lafayette St., New York.

GENERAL SUPERINTENDENT will be open for position by the middle of August. Large experience designing and building gas engines. Address Box 294, care MACHINERY, 49 Lafayette St., New York.

ITALY.—WANTED AGENCY of large American firm that wishes to begin or develop important business in Italy. Good occasion Universal Exhibition Turin 1911 (Office 41 Union Square, Room 1014, New York). BERNOULLI & CABIBI, Turin. House founded 1878. First-class references in United States.

MACHINISTS WANTED.—Men experienced at assembling the mechanism of crane bridges. Address box 183, Detroit, Mich.

MACHINE TOOLS, AUTOMATIC MACHINERY, special machinery and devices designed and detailed. Inventions and new ideas developed. S. C. CARPENTER, Plainville, Conn.

OILSTONE HOLDER mailed for 25c. Shop agents wanted. F. J. BADGE, 286 Taaffe Place, Brooklyn, N. Y.

PATENTS.—H. W. T. Jenner, patent attorney and mechanical expert, 608 F St., Washington, D. C. Established 1883. I make a free examination and report if a patent can be had and the exact cost. Send for full information. Trade-marks registered.

SITUATION OPEN in Middle West to draftsman experienced in threshing machinery. Address box 321, care MACHINERY, 49 Lafayette St., New York.

THE LESSEE, a machinist, of a Foundry and Machine Shop, wants partner to join him in buying the plant. Growing business and good opportunity. Mechanic or capable business manager preferred. Address J. C. KOEHLER, Baker City, Oregon.

WANTED.—Agents, machinists, tool makers, draftsmen, attention! New and revised edition Saunders' "Handy Book of Practical Mechanics" now ready. Machinists say "Can't get along without it." Best in the land. Shop kinks, secrets from note books, rules, formulas, most complete reference tables, tough problems figured by simple arithmetic. Valuable information condensed in pocket size. Price postpaid $1.00, cloth; $1.25 leather with flap. Agents make big profits. Send for list of books. E. H. SAUNDERS, 216 Purchase St., Boston, Mass.

WANTED—At once, a Mechanical Draftsman for detail work on cranes and electrical machinery. State salary and experience. SPRAGUE ELECTRIC CO., Bloomfield, N. J.

WANTED—FOREMAN for die tool-room. Must be expert on dies for general line of sheet metal work. THE TOLEDO MACHINE AND TOOL CO., Toledo, O.

WANTED.—SALESMEN to handle on a generous commission basis a well advertised and quick-selling line of lathe tools. Commissions given on all orders received from prescribed territory. Send references with reply. Address R. T., care MACHINERY, 49 Lafayette St., New York.

WANTED—SUPERINTENDENT-FOREMAN for machine shop. Experienced in heavy duty, commercial and gasoline engines. Must be good executive and able to produce results. Give full particulars. Address Box 298, care MACHINERY, 49 Lafayette St., New York.

WANTED—SHOP MANAGER for fabricating shop, handling about 25,000 tons of bars per annum. Technical graduate preferred. High-grade position. Only experienced men need apply. CORRUGATED BAR CO., Nat'l Bank of Commerce Bldg., St. Louis, Mo.

WE ARE INCREASING OUR FORCE and invite applications from machine hands of all kinds, including men who can turn multiple throw cranks, bench hands, erectors, metal polishers, and Jones & Lamson turret lathe hands. Shop located near Philadelphia and building marine gas engines. No labor troubles. Give experience in detail. Address box 293, care MACHINERY, 49 Lafayette St., New York.

WANTED—FIRST-CLASS MACHINISTS, steady work, good wages, nine hours. Write, giving reference, to UNITED METAL TRADES ASSOCIATION, 222 Commercial Club Bldg., Portland, Ore.

WANTED—POSITION AS ASSISTANT SUPERINTENDENT or Foreman by a mechanic with sixteen years' general all-around machine shop and tool-room experience in first-class machine tool-building plants. Now in responsible position. Able to design jigs and fixtures. Possesses executive ability and can produce results; good habits; age thirty-six. Address box 301, care MACHINERY, 49 Lafayette St., New York.

WANTED IN AUGUST.—A strictly high-grade Executive Factory Manager who is now commanding at least $5000 per year; not over forty years of age. Give full details as to experience, and references. Salary secondary consideration. Address box 303, care MACHINERY, 49 Lafayette St., New York.

WANTED.—Thoroughly experienced Time-operation and Machine-study man. Give fully experience and references. Highest salary paid for right man. Address box 304, care MACHINERY, 49 Lafayette St., New York.

WANTED—MACHINE SHOP FOREMAN accustomed to machine tool manufacture on economical lines and designer of jigs for same. State age, experience and salary. Correspondence confidential. Address box 306, care MACHINERY, 49 Lafayette St., New York.

WANTED—INSTRUMENT MAKERS accustomed to Precision work on Surveying Instruments and other high grade apparatus. Only those need apply who are confident of their ability to do such work. Attractive and steady positions to industrious men of good habits. In applying state age, nationality, where employed for the past three years, also salary received. Give reference and salary expected. All correspondence will be held strictly confidential. BAUSCH & LOMB OPTICAL CO., Rochester, N. Y.

WANTED—POSITION AS FOREMAN by a practical mechanic with executive ability, well up in modern machine shop and tool room practice, with twenty-two years' experience, now holding similar position. Good reference, location immaterial. Address box 305, care MACHINERY, 49 Lafayette St., New York.

WANTED—POSITION AS ASSISTANT SUPERINTENDENT or General Foreman by dependable man with 12 years' experience. Tool and model work for kerosene burners and stoves. Practical draftsman. Address BRISTOL, care MACHINERY, 49 Lafayette St., New York.

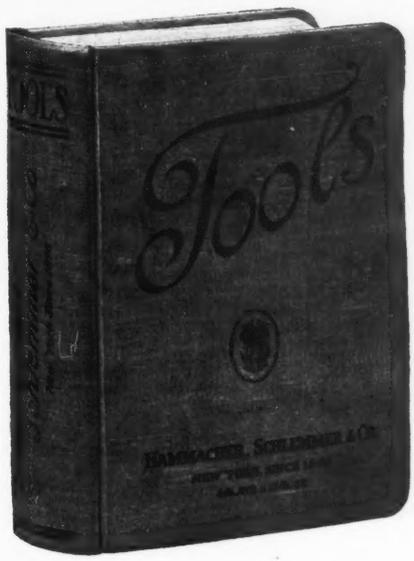
WANTED—First-class automobile draftsman with some executive ability, capable of directing 12 or 15 men. Address box 309, care MACHINERY, 49 Lafayette St., New York.

WANTED—BLACKSMITH FOREMAN in Chicago. Must be expert at dies for Forging Machines, Bulldozers and Steam Drops. Address box 308, care MACHINERY, 49 Lafayette St., New York.

WANTED—A first-class mechanical draftsman on details and layouts. A good opportunity for a bright, energetic man. Must be quick and accurate. Give age, reference, experience, and rate expected. Address box 1021, Bridgeport, Conn.

WANTED—By a manufacturing concern in Ohio, building general machinery, a foreman for milling and gear-cutting department. Also an expert tool-maker. Give age, experience and salary wanted. Reply, N-1, care MACHINERY, 49 Lafayette St., New York.

WANTED—DRAFTSMAN, experienced in sheet metal and automobile frame tool designing. Chance for advancement. DETROIT PRESSED STEEL CO., 1800 Mt. Elliott Ave., Detroit, Mich.



IT ISN'T TRUE

that the man around the corner carries all the tools you need, but it's more than likely true that you haven't given the tool question much attention.

IN THIS 1,200-PAGE CATALOG WE PRESENT

35 pages of Files
52 pages of Saws
27 pages of Clamps
54 pages of Reamers
56 pages of Drills, etc.
30 varieties of Screwdrivers
95 pages of Machinists' Tools
45 varieties and 32 pages of Wrenches
Etc., etc.

Just glance through your copy or pass it out to your men and let it be known that a Club Order can be sent in and we can ship with your other goods.

Equip your men with up-to-date tools and they will give you better results.

HAVE YOU A COPY ?

IF NOT, ASK FOR CATALOG No. 2815.

HAMMACHER, SCHLEMMER & CO.

Hardware, Tools and Supplies

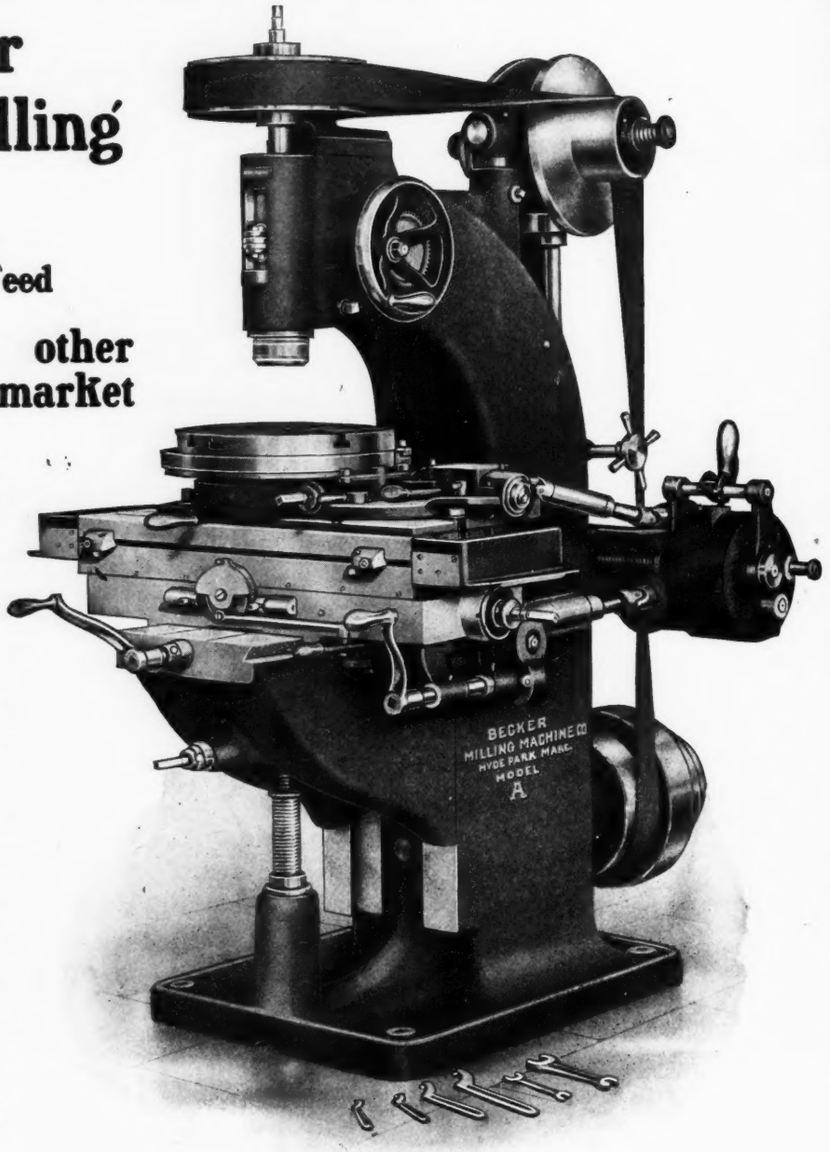
4th Avenue and 13th Street **NEW YORK, SINCE 1848**

More Work per Horse Power can be Obtained from the

New Becker Vertical Milling Machine

With Friction Feed

than from any other Miller on the market



Direct drive, powerful feed mechanism and absolute freedom from vibration give this machine a long lead on competitors. There is no power wasted in a complicated gear drive, the greater part of the work being done with the direct open belt, though for heavy cuts the back gears can be thrown in.

A special feature of the new Becker is the Friction Feed. Simple in design, this feed develops the greatest efficiency; the power available to drive the feed always increases automatically with that required to drive the cutter; the greatest number of changes is available, range is wide and durability quite unparalleled.

For general milling the New Model A will be found an economical and rapid producer of the best class of work. Special circular mailed on request.

The Becker Milling Machine Co.

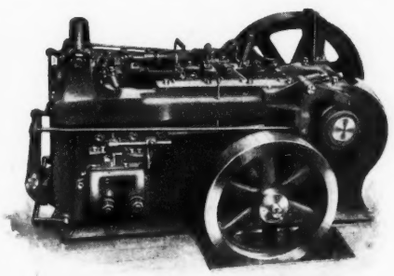
HYDE PARK, MASS., U. S. A.

AGENTS—Niles-Bement-Pond Co., New York. McDowell, Stocker & Co., Chicago. Selson Engineering Co., Ltd., London, England. Schuchardt & Schutte, Berlin, Germany; Vienna, Austria; Stockholm, Sweden; St. Petersburg, Russia; Copenhagen, Denmark; Budapest, Hungary; Shanghai, China; Tokio, Japan.

The Machines of Our Forefathers

Served their purpose then, because they were the best and only ones they had. The manufacturers of today could not use them—neither can they profitably use many other so-called modern machines because they fail to give them the greatest possible service for profitable returns. Manufacturers must produce results.

WE ARE THE OLDEST EXCLUSIVE BUILDERS OF HOT METAL WORKING MACHINERY IN THE WORLD.



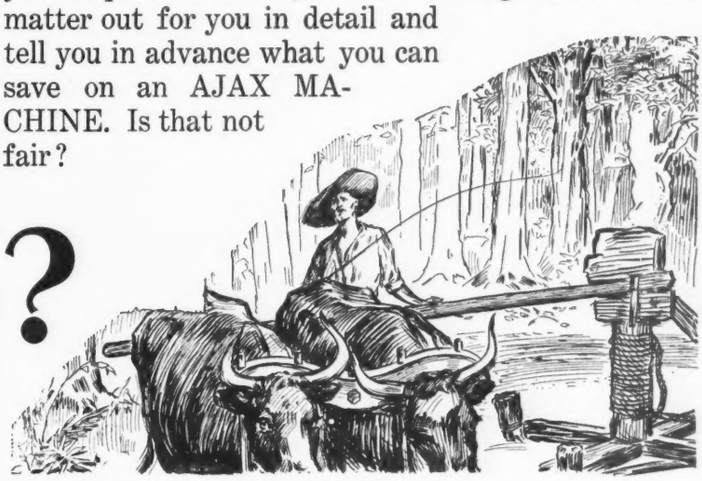
Ask the Man Using

AJAX
FORGING MACHINERY

What he is saving by using them. We are willing to let him answer.

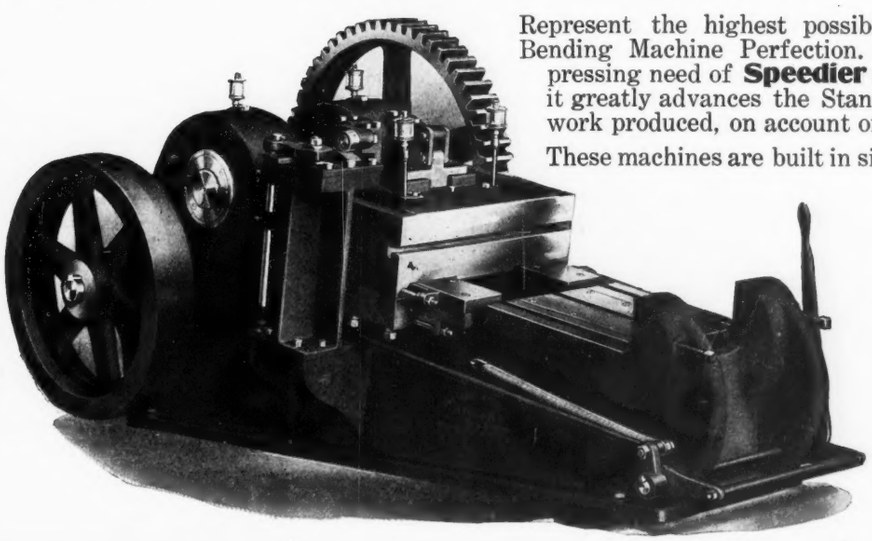
And we are ready to prove—at our risk—that Ajax Machines will yield the greatest possible net earnings, economizing cost, time and labor.

That is an open challenge we give you and every builder of Forge Shop Machinery, and we solicit your accepting it—in every test we claim. Write us what your requirements are, and we will figure the whole matter out for you in detail and tell you in advance what you can save on an AJAX MACHINE. Is that not fair?



?

AJAX High Speed Stop Motion Bulldozers

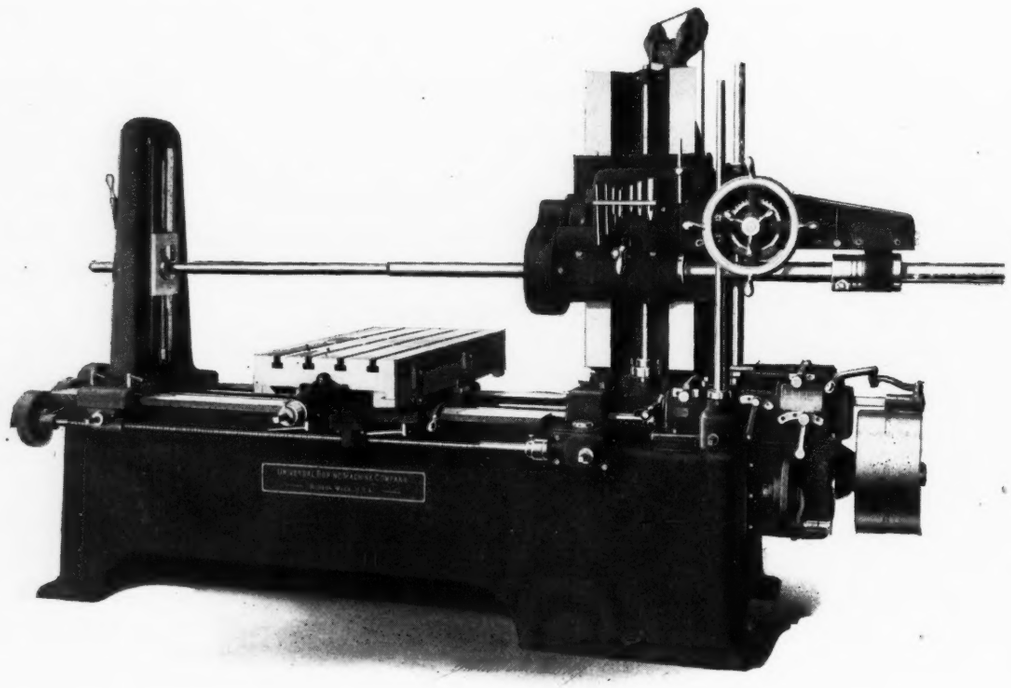


Represent the highest possible type of Bulldozer of Bending Machine Perfection. Besides supplying the pressing need of **Speedier Machinery** of its class, it greatly advances the Standard and Quality of the work produced, on account of its rapid operation.

These machines are built in sizes No. 1 to No. 7 inclusive and operate at from 30 to 60 Strokes per minute. The Bed is Steel, all Gears are CUT and all principal Bearings are Phosphor Bronze Bushed.

WRITE FOR REFERENCE BOOK.

The Ajax Mfg. Co.
3805 Lakeside Ave.
CLEVELAND, O., U.S.A.



Universal (Horizontal) Boring Machine With Rapid Milling Feeds

A Great Increase in Production

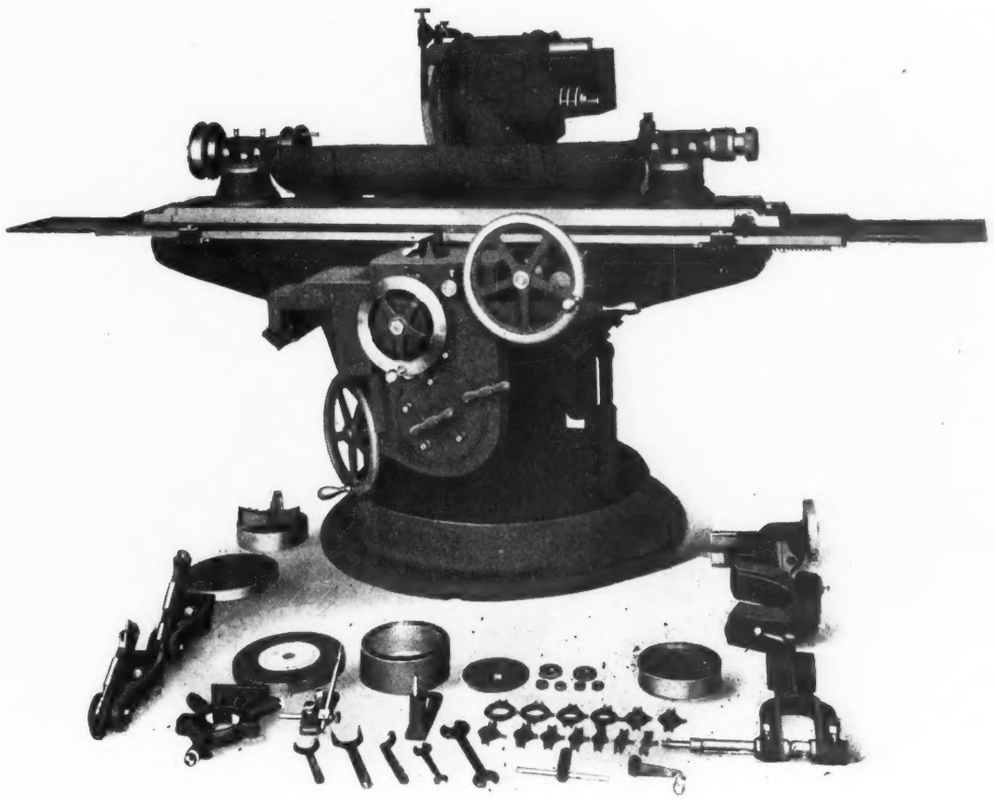
can be obtained on the Universal (Horizontal) Boring Machine, as work may be bored, milled and drilled with but one setting of the casting. The machine is equipped with automatic longitudinal and cross feeds to the table, and a regular and quick automatic vertical feed to the head.

Distributors

Hill, Clarke & Co., Inc.

Boston Chicago
Cleveland
New York Philadelphia

Universal Boring Machine Co.
Hudson, Mass.



THE THOMPSON UNIVERSAL GRINDING MACHINE

With Stationary Grinding Head

and

Perfect Water Attachment

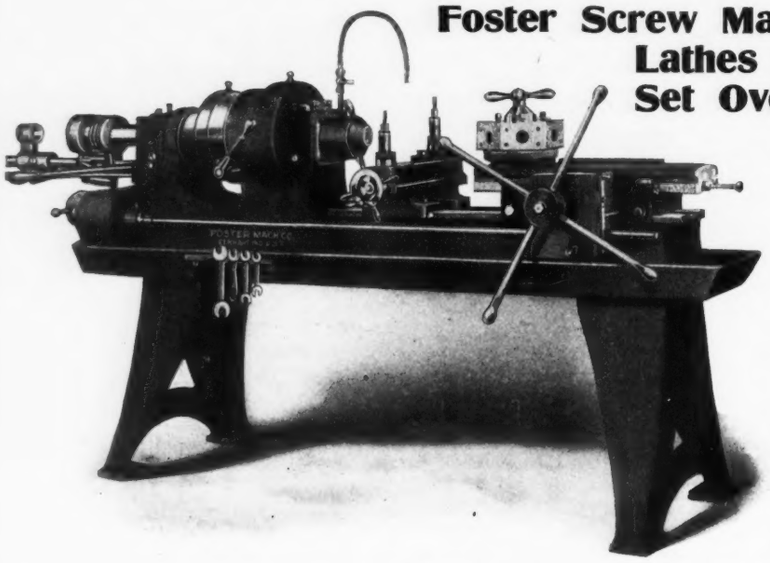
Distributors
HILL, CLARKE & CO., Inc.
Chicago
Boston
New York
Cleveland
Philadelphia

Manufactured by
THE THOMPSON GRINDER CO.
SPRINGFIELD, OHIO, U. S. A.

Foster Features that are Financial Factors

in the rapid production of duplicate machine parts and are incorporated in

Foster Screw Machines, Foster Turret Lathes and Foster Universal Set Over Turret Lathes



are as follows:

Independent stops for each hole in the turret.

Quick Change Gears to the power feed.

Adjustability in all directions—allowing re-alignment when worn out of true, and in all Foster Universal Machines. Independent stops to the turret slide—an advantage not found in any similar machine.

You can save money, insure accuracy and handle a wider range of work with Foster Machines.

Screw Machines have capacity from ¾″ to 4½″—Turret Lathes take work from 10″ to 24″ swing and Set Over Lathes 16″ to 18″ swing.

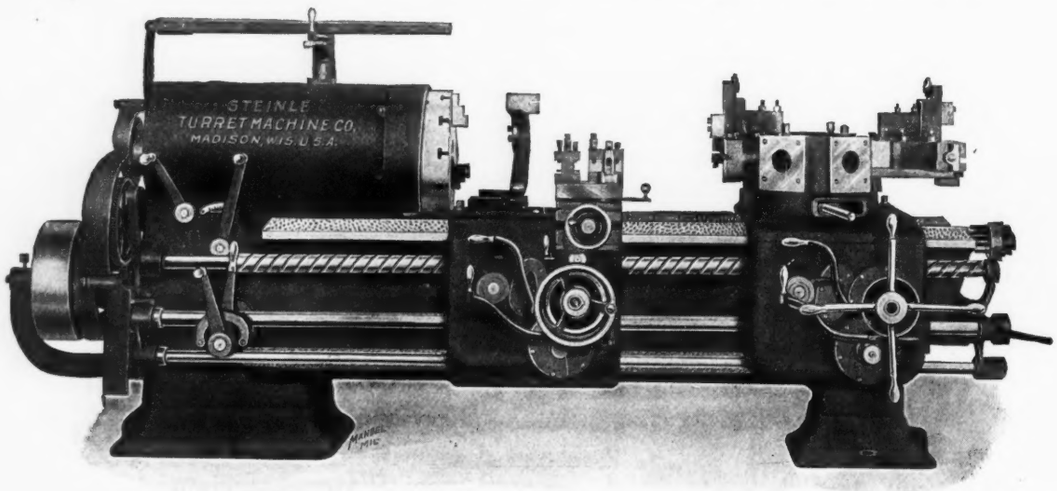
Ask us for estimates on your line of work.

Foster Machine Co., 1100 Beardsley Ave., Elkhart, Ind.

AMERICAN AGENTS—The H. A. Stocker Machinery Co., Chicago, Ill. C. C. Wormer Machinery Co., Detroit, Mich. Manning, Maxwell & Moore, New York, Philadelphia, Pittsburg, Syracuse, Buffalo, Cleveland, St. Louis, Atlanta, Ga., Milwaukee, Wis., Portland, Ore., Seattle, Wash., Boston, Mass., Chicago.

FOREIGN AGENTS—Manning, Maxwell & Moore, Japan, China and Philippine Islands. Schuchardt & Schutte, London, England. A. R. Williams Machinery Co., Toronto, Ontario. Williams & Wilson, Montreal.

Steinle Full Swing Side Carriage Turret Lathe



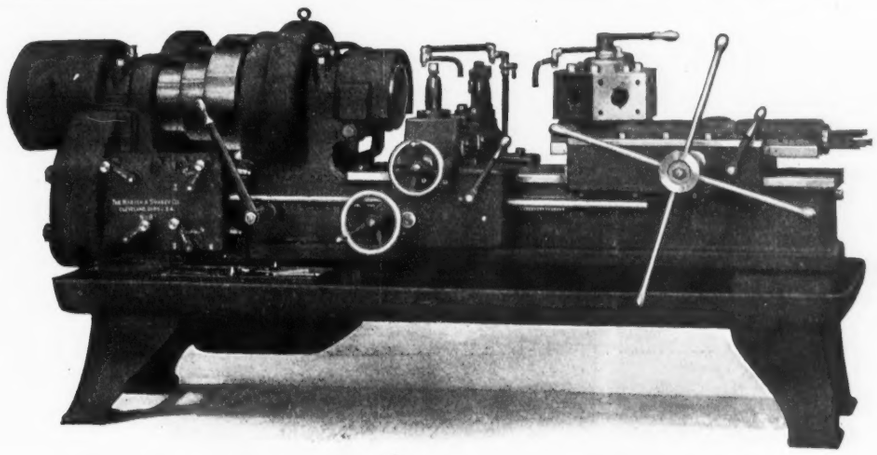
Pre-eminently a manufacturing machine with every advantage for the economical production of duplicate machine parts, it has strength, rigidity, all operating conveniences and is built for the heaviest service. Tools have practically no overhang. Tool post carriage is arranged to run past the chuck. Both carriages are operated by power. Single drive. Thirty changes of speed all under immediate control. We shall be glad to send further description on request.

STEINLE TURRET MACHINE CO., Madison, Wis.

SELLING AGENTS

Manning, Maxwell & Moore, Inc., New York.
Atlanta, Boston, Chicago, Cleveland, Detroit, Milwaukee, Philadelphia, Pittsburg, St. Louis, Syracuse, Seattle, Portland, Japan, Mexico.

Ludw. Loewe & Co., A. G., Berlin.
Austria, Belgium, Denmark, France, Germany, Holland, Hungary, Italy, Norway, Romania, Russia, Spain, Sweden, Switzerland.



No. 8 Turret Screw Machine. Swing 20"—Automatic Chuck Capacity 3⅝" diameter.

THE WARNER & SWASEY COMPANY

CLEVELAND, OHIO, U. S. A.

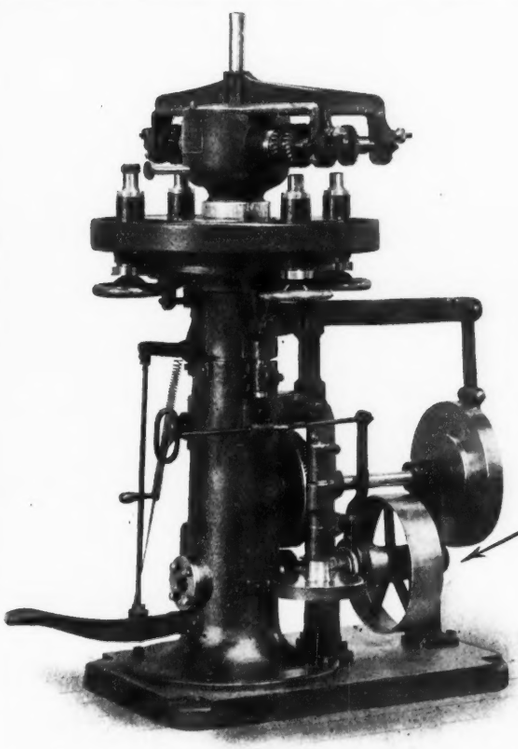
TURRET—LATHES

¶ There is a difference in Turret Lathes, especially between the "Warner & Swasey" and the ordinary kind.
¶ When you are in need of Turret Lathes confer with us before you purchase, as we have incorporated in our machines every modern facility for rapid, accurate and economical production.
¶ Then we have 25 years' specialized experience and we know what to recommend.
¶ Send us specimen of your work whether brass, iron or steel, and we will tell you what equipment is best suited for your requirements.
¶ We have helped others and can help you. Yours for the asking.

New York Office: Singer Bldg. *Detroit Office:* Ford Bldg. *Chicago Office:* Commercial National Bank Bldg.

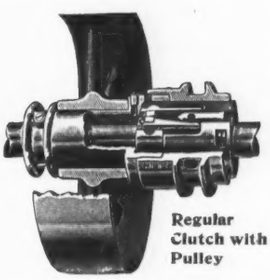
Foreign Agents: Chas. Churchill & Co., London, Birmingham, Manchester, Newcastle-on-Tyne and Glasgow. Schuchardt & Schutte, Berlin, Vienna, St. Petersburg, Stockholm, Copenhagen and Budapest. Alfred H. Schutte, Cologne, Paris, Brussels, Liege, Milan, Madrid, Bilbao and Barcelona. A. R. Williams Machinery Co., Toronto. Williams & Wilson, Montreal.

THE JOHNSON FRICTION CLUTCH



as used on "The Bemis Hexagonal Milling Machine" is only one instance of how this small compact clutch can be used in connection with almost any kind of machine built. One Johnson Single Friction Clutch with pulley, as per cut below, incorporated in this machine at point marked by arrow.

Send for Catalog "A" giving complete description of small compact clutches for use on feed and speed changes on machine tools.



Regular Clutch with Pulley

FOREIGN AGENTS—Efandem Co., 246a Corporation St., Birmingham, Eng., for Great Britain; Canadian Fairbanks Co., Montreal, Toronto, Winnipeg, Vancouver, Calgary and St. John, for Canada; Glaenzer, Perreaud & Thomine, No. 1 Ave. de la Republique, Paris, for France; Bieberstein & Goedicke, Ferdinanstr. No. 25-7, Amerikahaus, Hamburg, for Germany; Wilh. Sonesson & Co., Malmo, Stockholm and Gothenburg, for Sweden; Aktieselskabet Wilh. Sonesson & Co., Copenhagen City and Freeport, for Denmark, Norway and Finland; Louis Reifners, Amsterdam, for Holland and Belgium; R. d'Aulignac, Barcelona, for Spain.

THE CARLYLE JOHNSON MACHINE CO. MANCHESTER CONN

It has never been our custom to forward our interests by discrediting others

Lincoln-Williams High Speed Twist Drills

meet all competitors fairly and squarely and stand on their own individual merit.

We have centered all our forces and energies on making the best twist drill that could be offered—

Lincoln-Williams High Speed Twist Drills

made from the finest materials, after improved patterns and under the supervision of trained mechanics are "The Perfection of Mechanical Art".

The staying qualities of these high grade, high speed drills have been so well demonstrated that their economy is firmly established. They meet the highest speeds of which modern drilling machines are capable, stand heavy feeds and do their full duty under all conditions.

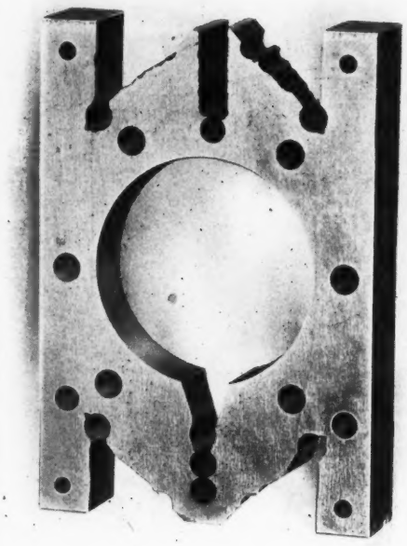
We can lessen your drilling costs by a considerable amount if you will use Lincoln-Williams High Speed Drills—full line of styles and sizes.

Catalogue on request.

Lincoln-Williams Twist Drill Co.

Taunton, Mass., U.S.A.

Steel for High Grade Dies



The making and working of high class dies is one of the tests that brings out the good qualities of the steel or shows up its deficiencies.

The die, here shown, made by a manufacturer of extremely fine and expensive dies, did not vary 1-10000" in the hardening, notwithstanding the unusual difficulties offered by reason of the many angles, holes and thin sections.

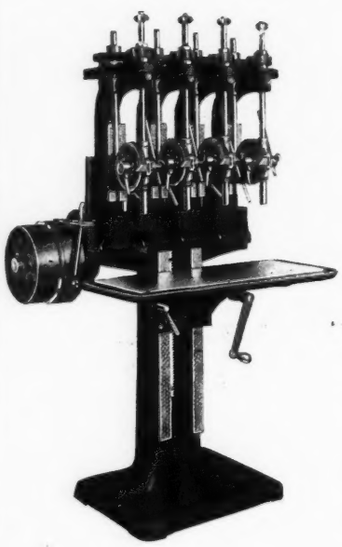
No change in hardening.

Our steels are particularly well adapted for die making—write us your requirements and give us a trial.

Cammell Laird & Co., Ltd., (Sheffield)
25 Cliff Street, NEW YORK CITY

Manufacturing Drills

Capacity ¼-inch to ¾-inch Holes



In convenience, speed, adaptability and simple but absolutely up-to-date construction these machines meet and pass all competitors. They are built in a wide range of sizes with five different types of heads, have positive gear drive and silent chain, thus avoiding the annoyances consequent to slipping or broken belts, frictional losses from tight belts and other belt troubles. There is power and rigidity to drive high speed drills to their full limit and a dependable accuracy that counts largely in the days work.

New catalogue showing all sizes will be sent on request.

The Taylor & Fenn Company

HARTFORD, CONN.

EUROPEAN AGENTS—E. Sonnenthal, Jr., Berlin, Cologne and Vienna. R. S. Stokvis & Zonen, Ltd., Rotterdam and Brussels. Alfred H. Schutte, Paris, Milan and Barcelona. Schuchardt & Schutte, Stockholm and Copenhagen.

"OWEN" No. 3 Plain or Universal

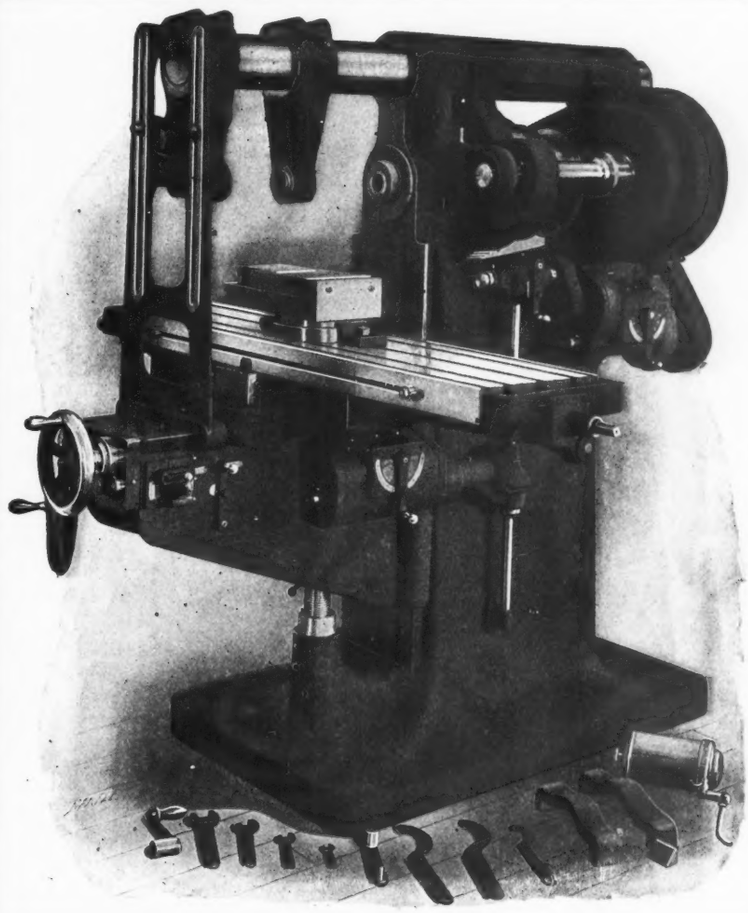
Catalog C.

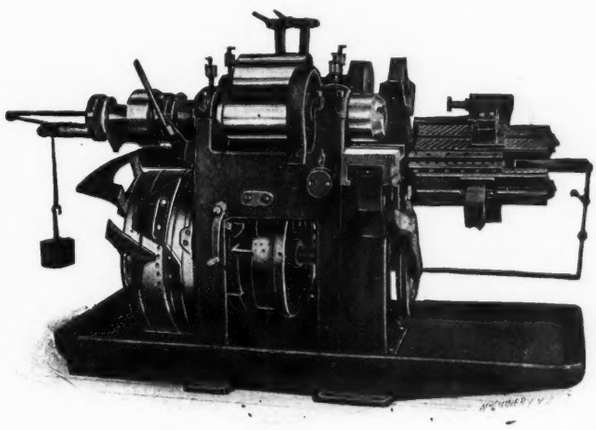
The Owen Machine Tool Company

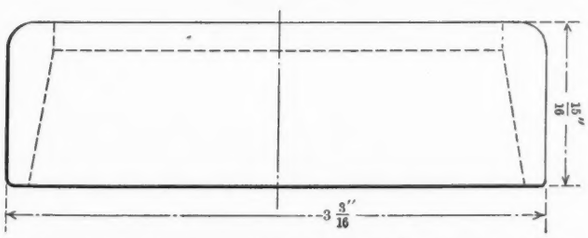
Dept. M, Springfield, Ohio

United States Selling Agents—Chandler & Farquhar Co., Boston, Mass. Vandyck Churchill Co., New York and Philadelphia. Syracuse Supply Co., Syracuse and Buffalo, N.Y. Somers, Fitler & Todd Co., Pittsburg. C. C. Wormer Mchy. Co., and C. A. Strelinger Co., Detroit. Patterson Tool & Supply Co., Dayton, O. and Indianapolis, Ind. B. A. Tozzer, Rockefeller Building, Cleveland, O. O. L. Packard Mchy. Co., Chicago and Milwaukee. Fairbanks Co., New Orleans.

Foreign Agents—Alfred Herbert, Ltd., Coventry, Eng. DeFries & Co., Akt. Ges., Dusseldorf, Berlin and Stuttgart, Germany; Milan, Italy; Barcelona, Spain. Alfred Herbert, (France), Ltd., for Belgium and Switzerland. Alfred Herbert, Ltd., Yokohama, Japan.







We average 150 pieces per working day of ten hours on jobs of this class. Glad to estimate on your work.

We don't claim anything for GRIDLEY AUTOMATICS that the Machines do not back up—

We can assure—Perfect and permanent alignment

Absence of overhang to turning tools or their support

Tools of the highest efficiency

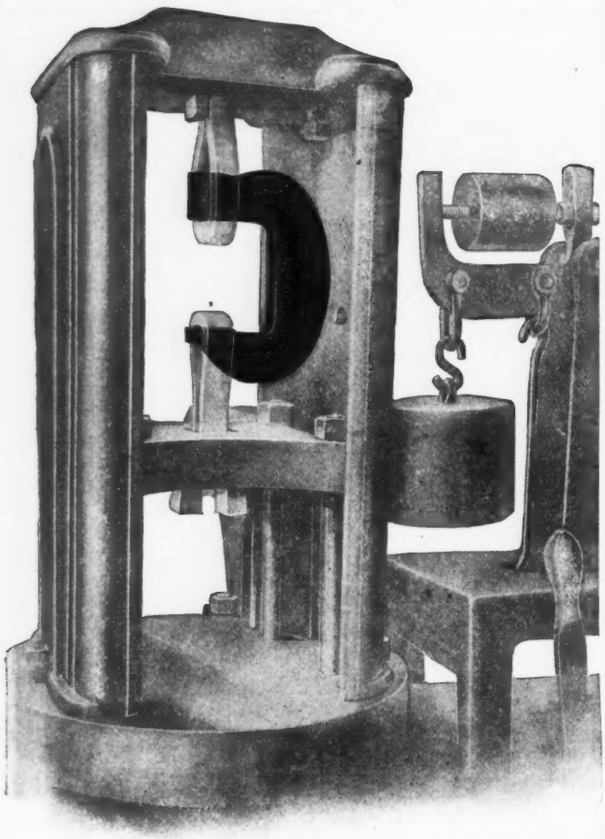
Constant high speed movement of all parts when the tools are not cutting—

All features peculiar to Gridley Machines and productive of rapid, accurate, well finished work.

We can also handle longer work on the Gridley than is possible on any other automatic and offer greater operating convenience.

WINDSOR MACHINE COMPANY, Windsor, Vermont

Manning, Maxwell & Moore, Inc., Sales Agents, New York, Philadelphia, Pittsburg, Cleveland, Chicago, Buffalo, Detroit, Indianapolis, San Francisco, Milwaukee and St. Louis. M. Koyemann, Charlottenstrasse, 112 Dusseldorf, Germany, Holland, Belgium, Switzerland and Austria-Hungary. Craven Bros., Ltd., Vauxhall Works, Manchester, England, Sole Makers for Great Britain and the Colonies and South America.



FF
"VULCAN"

The first and last requirement of "C" Clamps is stability (**fixed fact.**)

"Vulcan C" Clamp strength does not encumber design (**fixed fact.**)

"Vulcan C" Clamps displace the inherent weakness in this form of tool (**fixed fact** and test proves it.)

The average elastic limit of "Vulcan C" Clamps is over 20,000 lbs. per tool (**fixed fact;** testing machine proves it.)

The easiest and first thing to be forgotten about "Vulcan C" Clamps **is the price (firmly fixed fact.)**

The unusual design, strength and service in "Vulcan C" Clamps suggest that you equip first, last and always with **Williams' "Vulcan" Tools.**

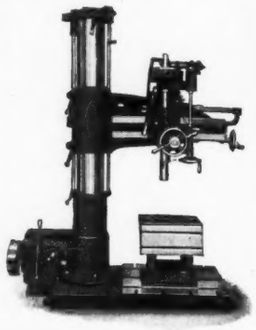
Discount from the dealer; machine shop catalogues free.

J. H. Williams & Company

Superior Drop-Forgings

61 Richards Street BROOKLYN, N. Y.

Strength



The **patented one piece column** of our make Radial Drill insures **perfect rigidity** and **elimination** of all vibration, both essential to true work. This column has **four internal webs** extending its entire length, which add to its stiffness. This is **only one** of the valuable features of our machine; there are many others **worth knowing.**

How about getting our literature? It's Free.

THE MUELLER MACHINE TOOL CO.
Radial Drill Specialists
CINCINNATI, OHIO, U. S. A.

SPIRAL GEARS
Our Specialty

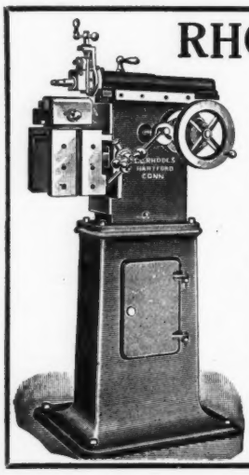
We also have excellent facilities for turning out spur and worm gears of guaranteed accuracy at moderate prices.

We are in position to make prompt deliveries, and we solicit an opportunity to estimate on your requirements.

CARPENTER-KERLIN GEAR AND MACHINE COMPANY

77 White Street New York City

RHODES SHAPERS



This is our 7" Shaper which has all the essential features of the high priced machine, and is especially adapted for all kinds of light tool and die work, and any class of work that comes within its range.

Has Micrometer adjustments and graduated swivel vise and head.

Can you afford to be without this LITTLE MONEY MAKER? Send for circulars to

L. E. RHODES
HARTFORD -- CONNECTICUT

WHEN THE CENSUS MAN WENT ROUND

If he had kept score of the number of **skilled workers—machinists, toolmakers** and others—who are using **American Swiss Files** to the exclusion of other brands, there would have been some **surprising figures.**

AMERICAN SWISS

Files have come to stay. We are making new friends every day, but what's more to the point, we keep our old friends. You can persuade a man to *try* a new thing, but it must have **quality—dependable, ingrained quality**—before he will "tie to it".

We should like to send a few *free* sample files as **"persuaders"**—they will do the rest themselves. Your preference in size, shape and cut written on your *business letter head* will bring the samples.

Address nearest agency below.

American Swiss File and Tool Company

24 John Street, New York, N. Y.

DISTRIBUTORS:

E. P. REICHHELM & CO., 24 John St., New York.
THE MACHINISTS' SUPPLY CO., 119 No. Canal St., Chicago, Ill.
THE BOYER-CAMPBELL CO., 64 Congress St., Detroit, Mich.
DUCOMMUN HARDWARE CO., 300 No. Main St., Los Angeles, Cal.
CHANDLER & FARQUHAR CO., 34 Federal St., Boston, Mass.
CHAS. A. STRELINGER CO., 96 Bates St., Detroit, Mich.
WHITE TOOL & SUPPLY CO., 1313 Sixth St., N. W., Cleveland, O.
TRACY, ROBINSON & WILLIAMS CO., Hartford, Conn.
THE MACHINISTS' SUPPLY CO., 324 Third Ave., Pittsburg, Pa.

Bearing vs. Wearing

The solution to the question, in so far as it concerns High Speed Drilling, is found in the inserted, interchangeable bearings of

Henry & Wright Drilling Machines

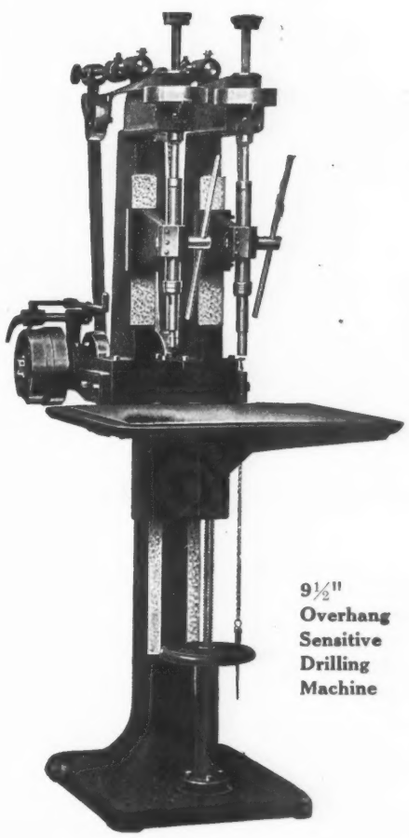
Wearing never ceases, yet by this plan it not only decreases but becomes a secondary consideration in the life of our machines.

They allow a **200** to **400** per cent. production increase and speeds that would destroy an ordinary machine. Bearings seldom need replacement and guarantee a new length of life and service with each renewal.

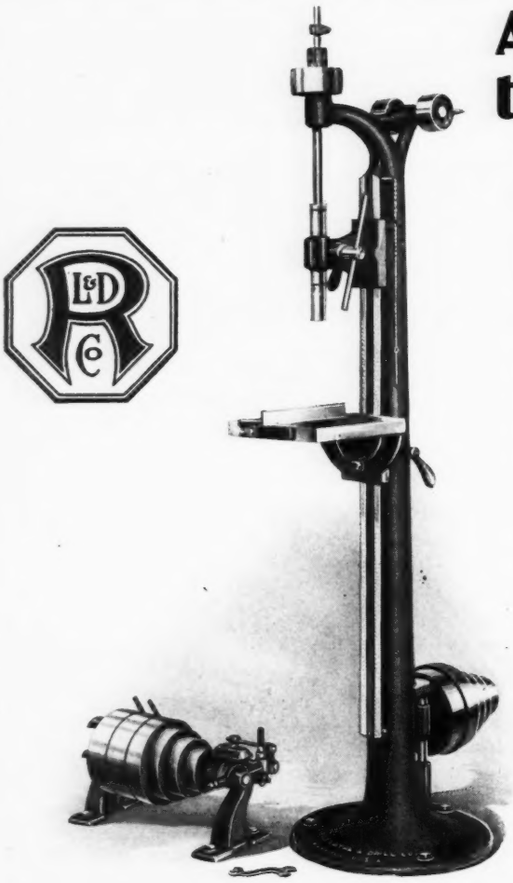
9½", 12", and 15" Overhang.

Catalogue on request.

THE HENRY & WRIGHT MFG. CO.
HARTFORD, CONNECTICUT, U. S. A.



9½" Overhang Sensitive Drilling Machine



A New Sensitive Drill in the Rockford Line

In offering the **Rockford 13-inch Sensitive Drill** we aim to provide a rigidly built, high grade machine that will handle the lighter grades of drilling quickly and efficiently. It has capacity up to ¾" holes and is fitted with square table vertically adjustable on the column. A feature of the table is the bracket for angular drilling. In common with our other new model drilling machines, the driving cone is placed at the base of the column and has an adjustment of three inches for tightening the belt.

It does not take much money to buy this machine and it is the *money's worth* in full.

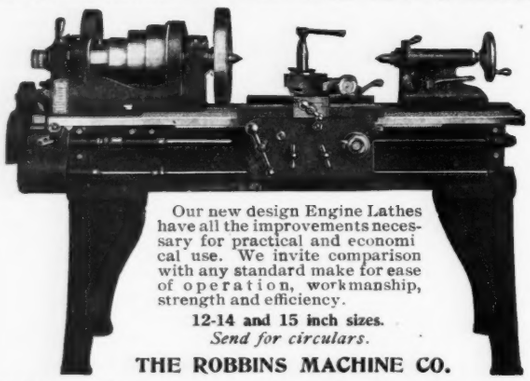
Special circular or full catalogue on request.

Rockford Lathe & Drill Co.

Rockford, Ill., U. S. A.

AMERICAN DEALERS: O. L. Packard Mchy. Co., Chicago, Ill., Milwaukee, Wis. Prentiss Tool & Supply Co., New York, N. Y., Syracuse, N. Y., Buffalo, N. Y., Boston, Mass. Baird Mchy. Co., Pittsburgh, Pa. E. A. Kinsey Co., Indianapolis, Ind., Cincinnati, O. W. M. Pattison Supply Co., Cleveland, O. W. R. Colcord, St. Louis, Mo. Harron, Rickard & McCone Co., San Francisco, Cal., Los Angeles, Cal. Northern Mchy. Co., Minneapolis, Minn. Zimmerman-Wells-Brown Co., Portland, Ore. The English Tool & Supply Co., Kansas City, Mo. The National Supply Co., Toledo, O. Chas. A. Strelinger Co., Detroit, Mich. Vandyck-Churchill Co., Philadelphia, Pa. Aumen Mchy. Co., Baltimore, Md. Hendrie Bolthoff Mfg. Co., Denver, Col.

ROBBINS ENGINE LATHES



Our new design Engine Lathes have all the improvements necessary for practical and economical use. We invite comparison with any standard make for ease of operation, workmanship, strength and efficiency.

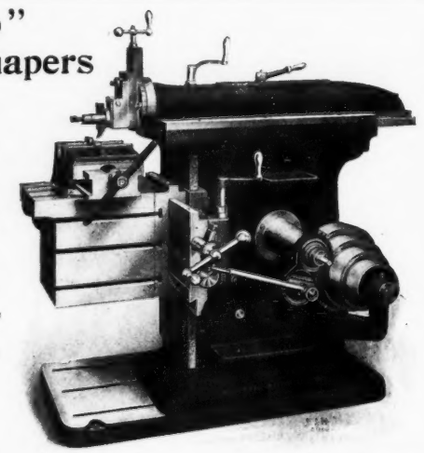
12-14 and 15 inch sizes.

Send for circulars.

THE ROBBINS MACHINE CO.

149 Lagrange Street **Worcester, Mass., U. S.A.**

"Ohio" Crank Shapers



A complete line—16", 18", 22" Single and Back Geared; also 24" Back Geared and 21", 28" Triple Geared machines.

Planers in sizes from 24" to 48".

Our circulars give full description.

The Ohio Machine Tool Co.

Kenton, Ohio

New Shop Receipts and Formulas

412 RECEIPTS AND FORMULAS, CLASSIFIED AND INDEXED

61 PAGES, STANDARD SIZE, 6 x 9 INCHES, CLOTH BINDING

The old and very successful paper-covered edition of MACHINERY'S Shop Receipts and Formulas contained exactly 150 Receipts. The new, greatly enlarged and carefully edited cloth-bound edition contains 412 Receipts and Formulas, all selected from back numbers of MACHINERY, classified and arranged in groups which greatly enhance the value of the book. There is, besides, a complete index for quick reference.

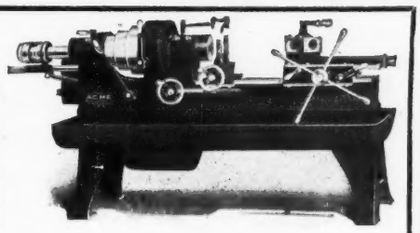
The price of this useful book is $1.00, and there are receipts in it worth ten dollars each to any man in need of the information they contain.

MILWAUKEE LATHES

MILWAUKEE MACHINE TOOL CO.
Builders of High Grade Machine Tools
Milwaukee, Wisconsin

Massive Turret Slide and Saddle

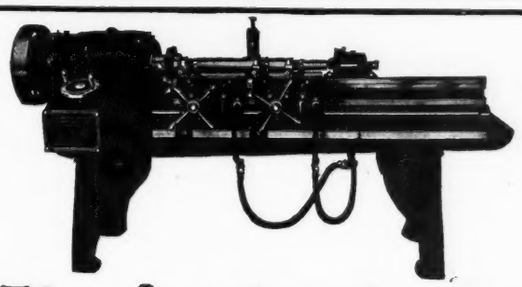
with extra strong head and powerful drive put



Cincinnati 2¼" Screw Machines

in line with the big producers. The hexagonal turret with six tool holes and binder bushings has bolt holes for securing tools to the faces, and is so arranged that stock to the full diameter of the hole can pass through the turret, allowing short, stiff tools to be used on long work. *Write for complete details.*

The Acme Machine Tool Co., Cincinnati, Ohio



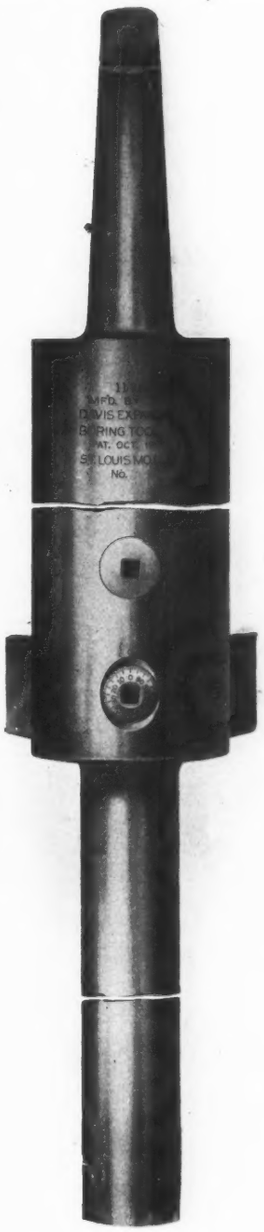
The So-swing Lathe

Does more than double the output of any engine lathe on the same work. Great driving power, rigidity, extreme accuracy and perfect control of work are but a few of its details. *Catalog?*

FITCHBURG MACHINE WORKS, Fitchburg, Mass.

IMPORTANT

Did it ever occur to you how ridiculous it is to purchase an improved up-to-date boring machine and then equip it with an old style boring tool? You are then compelled to operate this up-to-date machine at a speed that will prevent the boring tool cutters from wearing rapidly.



Why not eliminate this state of affairs and equip both your new and old machines with our **Improved Expansion Boring Tools.**

The cutters for these tools are really indestructible. They will enable you to get the maximum efficiency out of your boring machines at a minimum cost of maintenance—in all it means a saving of 50%.

We manufacture these tools exclusively; have supplied them to thousands of shops of every description and are in a position to substantiate every claim made. They are made in all styles and 21 sizes.

No shop complete without them.

Write today for circulars and price list.

Davis Expansion Boring Tool Company
Broadway and Bremen Ave., St. Louis, Mo.

Voluminous **AUGUST, 19 TEN** **Second Offense**

THE SPOTLIGHT

"Nothing but Views"

Published—Why, of course.
Subscription Price—Higher yet.
Circulation—Better than ever.
Editor—T. Paywell, Ph. B. C.
Office Boy—Impossible.

IS LIFE A GRIND TO YOU?

To the preacher life's a sermon,
To the joker it's a jest;
To the miser life is money,
To the loafer life is rest.

Life is but a long vacation
To the man who loves his work;
Life's an everlasting effort
To shun duty—to the shirk.

To the heaven-blest romancer
Life's a story ever new;
Life is what we try to make it—
Brother, what is life to you?

Away with the pessimist who says the world is growing worse. Working conditions, bad as they seem to-day, are not to be compared with the barbarous olden days.

Even in England, some centuries ago, if an ordinary workman moved from one parish to another without permission, in search of work or better wages, he was branded with a hot iron.

Consider the ever-increasing number of helps on simple operations such as grinding or cleaning castings. Not only is the old-fashioned way pure drudgery, but moving heavy, cumbersome work about is inconvenient, to say the least.

Now, a light, speedy tool which moves freely wherever required does the work more efficiently and in a fraction of the former time. This same outfit has several interchangeable tools which multiply its usefulness.

If life is a grind to you, we recommend a Coates Flexible Shaft Outfit—it shortens the grinding time.

EDITING THE SPOTLIGHT

You say it's a simple matter.

It is (if you only have to read it) but with our foreman at home shot three times, a printer in the jail half-shot, another in the office not worth shooting, the SPOTLIGHT is issued under difficulties this month.

But to come to the point. Some of our readers have had interesting experiences with Coates Flexible Shafts and Tools. Many users have reduced working time on several operations to one-half or one-third of that formerly necessary.

The Editor would like a few details of these things first-hand. Just drop him a line addressed: "Editor of THE SPOTLIGHT, care Coates Clipper Mfg. Co., Worcester, Mass." It will be promptly acknowledged and possibly published here. Please let us hear from you soon—in time for the next issue if possible.

SUMMER BOARDERS—"Haow do them summer boarders of yourn keep busy?" "They play golf." "What'n Sam Hill's that?" "'S near's I kin figger, it's solitaire shinny."

YOU can fool udder peoples some of der time, but you can fool yourself all der time.

NERVE CURE—"Prisoner, are you guilty or not guilty?" "Let my lawyer plead not guilty for me, judge; I ain't got the nerve."

COMPANION WANTED—The absent-minded professor returned home one evening, and, after ringing his front door bell for some time to no effect, heard the maid's voice from the second-story window, "The professor is not in."

"All right," quietly answered the highly educated man, "I'll call again." And he hobbled down the stone steps.

SOME mens go through dis vorld on der brincible dot der more noise dey make, der more salary dey vas vorth py pay day on.

Please Mention THE SPOTLIGHT Ad.

The COATES Way—1910

200 years ago they cleaned castings by hand. But up-to-date manufacturers cannot afford to use slow, costly methods especially when one

Coates Flexible Shaft Outfit

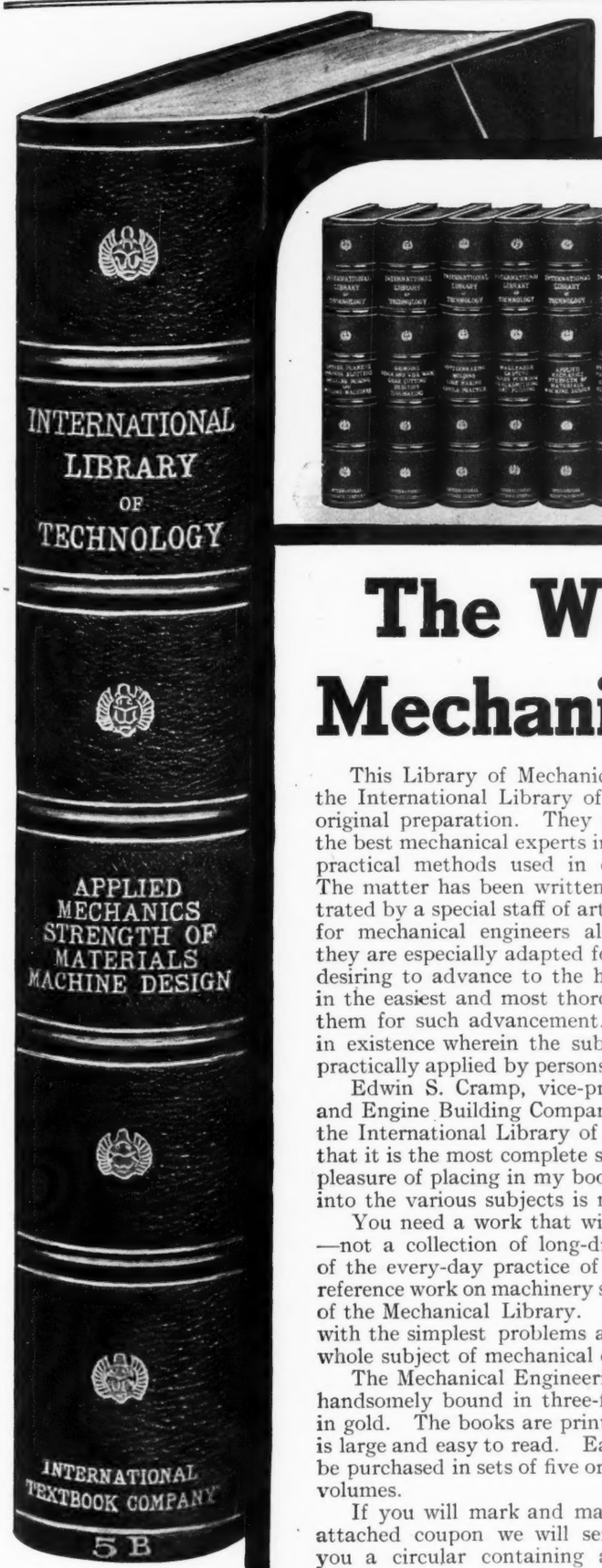
does the work of several different tools and as many men.

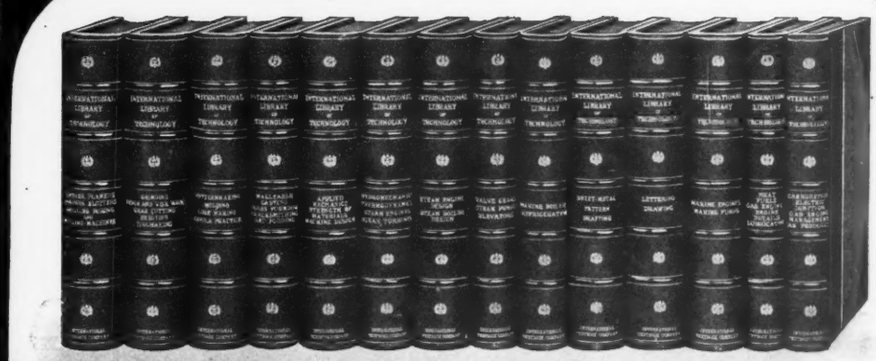
Grinding is only one of the possibilities. Drilling, surfacing, snagging, scratching, polishing, chipping, boring, etc., are all within its capacity.

The outfit takes the place of sand blast in removing rust, and for slicking up metal work or preparing castings so the paint will look smooth. It can't be equaled either in point of economy or efficiency.

Catalogue 22 will tell you many things of interest. Have you a copy?

Coates Clipper Mfg. Co.
Worcester, Mass.





The World's Best Mechanical Library

This Library of Mechanical Engineering is part of the 99 volumes of the International Library of Technology that cost over $1,500,000 in its original preparation. They contain the results of years of experience of the best mechanical experts in the country. They contain the best modern practical methods used in every branch of the mechanical profession. The matter has been written by the foremost technical experts and illustrated by a special staff of artists and craftsmen. Not only are they suited for mechanical engineers already well trained in their profession, but they are especially adapted for the use of those learning the profession and desiring to advance to the higher places, and those that wish to acquire in the easiest and most thorough manner the knowledge that will qualify them for such advancement. This Library is the only practical library in existence wherein the subjects treated can be readily understood and practically applied by persons having no knowledge of higher mathematics.

Edwin S. Cramp, vice-president of the William Cramp & Sons Ship and Engine Building Company, of Philadelphia, says: "I have examined the International Library of Technology and have no hesitancy in saying that it is the most complete set of technical books that I have ever had the pleasure of placing in my bookcase. The thoroughness with which you go into the various subjects is marvelous."

You need a work that will explain to you the latest and best practice —not a collection of long-drawn-out, involved theories, but an epitome of the every-day practice of the foremost mechanical experts. No other reference work on machinery so fully merits this description as these volumes of the Mechanical Library. The volumes treat of practical work, starting with the simplest problems and covering in a comprehensive manner the whole subject of mechanical engineering.

The Mechanical Engineering Library contains 14 volumes durably and handsomely bound in three-fourths red morocco, stamped and numbered in gold. The books are printed on a high-grade book paper, and the type is large and easy to read. Each volume is 6 × 9 inches in size. They may be purchased in sets of five or more volumes.

If you will mark and mail the attached coupon we will send to you a circular containing a full description of all the volumes of the International Library of Technology. Every man engaged in mechanical work should know about our Library of Mechanical Engineering. Mark and mail the coupon **NOW.**

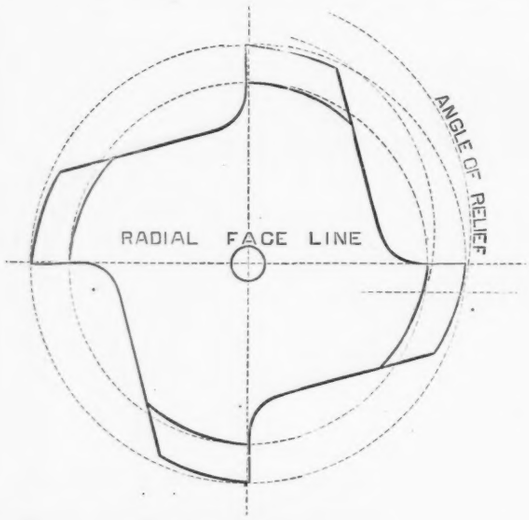
INTERNATIONAL TEXTBOOK COMPANY
Box 980, SCRANTON, PA.

Please send, without further obligation on my part, full description and particulars regarding the International Library of Mechanical Engineering

Name _____

Street and No. _____

City _____ *State* _____



The value of the MACHINE RELIEF as applied to the LIGHTNING TAPS is recognized by leading mechanics and they specify *"must be machine relieved"* on their requisitions.
Our method of relieving (every tooth separately) insures easy cutting and smooth, clean threads.
Easier for the workman and cheaper for the proprietor.

Send for catalog 34-E and full information.

SOLE MAKERS

WILEY & RUSSELL MFG. CO., Greenfield, Mass.

BRITISH AGENTS—Selson Engineering Company, 85 Queen Victoria Street, London, E. C.

Little Giant

TOOL TOPICS—TWO TESTS

All merchandise is subject to TWO general tests—the "eye" test and the "service" test. You have probably found that some tools are only built for LOOKS—in fact, just to SELL. And you know there are other tools that don't look very fine but get the work done.

LITTLE GIANT tools will pass BOTH tests. They are made FIRST to do the work RIGHT, to do a lot of it, to do it for a long time—and THEN we finish them to pass the "eye" test—you'll find them the best looking tools of their class on the market. They ARE right and they LOOK right.

Ask for them at your dealer's or write us direct for quotations. **"Their use becomes a habit."**

WELLS BROTHERS COMPANY

GREENFIELD, NEW YORK LONDON CHICAGO MASS., U. S. A.

How Do You Measure Up?

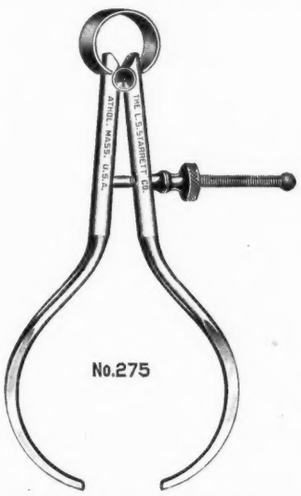
BY STEEL OR THE RULE-O'-THUMB?

Starrett Steel Rules

have long been famous for accuracy and convenience. They are made in numerous styles and sizes; the particular rule shown is 3-64ths inches thick, or 18 gage, and is graduated in 32ds on opposite sides of one end.

Starrett Steel Tapes

can be depended on—other materials stretch or shrink and thus impair the accuracy of measurements. Handle is flush and a slight pressure on the push button on opposite side releases the tape—finger nail, knife blade or screw driver not required for operating. A vest pocket tape you will swear by.



Starrett Toolmakers' Spring Calipers and Dividers

are superior to all old style instruments. Made in many types for outside or inside work, have stiff reliable bows and are preferred to higher cost tools. Duplicate parts can always be supplied.

Every Starrett tool is nickel-plated or otherwise nicely finished. Little conveniences, such as dissimilar figures for lessening errors in reading and other special features are added wherever practicable.

Send for the free Catalog No. 18-D and its supplement, showing the line of the largest plant in the world devoted exclusively to manufacturing small tools for mechanics.

The L. S. Starrett Co.

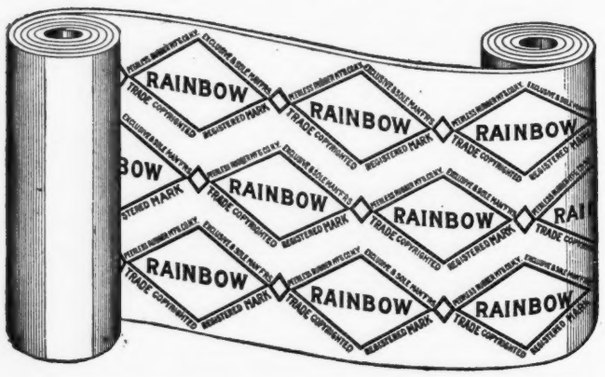
Athol, Mass.

NEW YORK CHICAGO LONDON

Rainbow Packing

Makes Steam, Flange and Hot Water Joints Instantly.

Thousands of Imitations. No Equal. Will Hold Highest Pressure.



Don't have to use wire and cloth to hold Rainbow. Can't blow it out.

THE COLOR OF RAINBOW PACKING IS RED

Notice our Trade Mark of the Word "RAINBOW" in a diamond in Black in

Three Rows of Diamonds extending throughout the entire length of each and every roll of Rainbow Packing

WILL CARRY IN STOCK **It is an undisputed fact that Rainbow Packing is the only Sheet or Flange Packing in the World that will carry in stock for months and years without hardening or cracking.**

The Peerless Spiral Piston and Valve Rod Packing

Once Tried Always Used.

It will hold 400 lbs. of Steam.

Will run twelve months in high speed engines.

In Boxes 3 to 8 lbs.

Made in Three Different Shapes: Straight, Spiral and Square Spiral, in sizes from 1-4 inch to 2 inches.

WRITE FOR CATALOG

MANUFACTURED, PATENTED AND COPYRIGHTED EXCLUSIVELY BY

THE PEERLESS RUBBER MFG. CO., 16 Warren Street, 88 Chambers Street, New York

24 Woodward Ave., Detroit, Mich.
202-210 S. Water St., Chicago, Ill.
38-42 S. Capitol Ave., Indianapolis, Ind.
111-121 W. Main St., Louisville, Ky.
1218 Farnam St., Omaha, Neb.
1323 E. Main St., Richmond, Va.
245-247 Master St., Philadelphia, Pa.
177 Elm St., Dallas, Texas.
1316-1318 A St., Tacoma, Wash.
Cor. Common and Tchoupitoulas Sts., New Orleans, La.
416-422 Mission St., San Francisco, Cal.
212-216 Jackson St., Seattle, Wash.
228 Front St., Memphis, Tenn.
1213 Locust St., St. Louis, Mo.
1556 Wazee St., Denver, Col.
1221-1223 Union Ave., Kansas City, Mo.
709-711 Austin Ave., Waco, Texas.
1016-1018 Railroad Ave., Spokane, Wash.
Cor. Long and Third Sts., Columbus, O.
212-214 S. Clinton St., Syracuse, N. Y.
425-427 First Ave., Pittsburg, Pa.
7-9 S. Broad St., Atlanta, Ga.
61 Frankfort St., Cleveland, O.
24 Exchange St., Rochester, N. Y.
110 Federal St., Boston, Mass.
379-383 Washington St., Buffalo, N. Y.
27-29 N. Front St., Portland, Ore.

ELECTRIC WELDING—
The "Toledo" Way

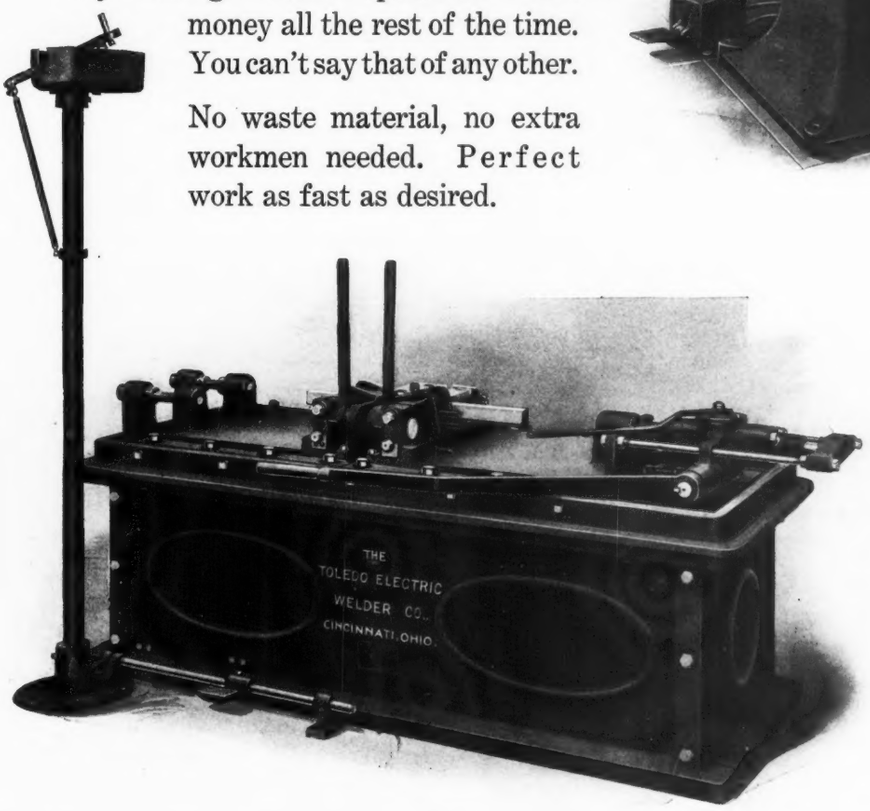
WILL SAVE A LOT OF MONEY

If you think it can't be applied in your business, let us tell the experiences of others who now do brazing, forging, riveting and numerous other operations the "Toledo" way.

We make a variety of styles and sizes—machines to weld everything from hair pins to propeller shafts—and guarantee a union of the most permanent nature in a fraction of the time required by the best of older methods.

The "Toledo" way is silent; costs money only during actual operation—saves money all the rest of the time. You can't say that of any other.

No waste material, no extra workmen needed. Perfect work as fast as desired.



We'll weld sample pieces for you, if at all practicable, and send a few facts and figures to show the value in your particular case. Whether you're open to conviction or not, the story will be interesting.

The Toledo Electric Welder Company

Station "A" **CINCINNATI, OHIO, U. S. A.**

No. 5 Size

9 in. Swing, 38 in. Bed

Van Norman Bench Lathes

with attachments for milling, etc., make a most complete outfit for all around Tool Fixture, Gauge, Experimental and Laboratory Work.

Three Sizes—Nos. 3, 3½, 5

Ask for Bench Lathe Catalog.

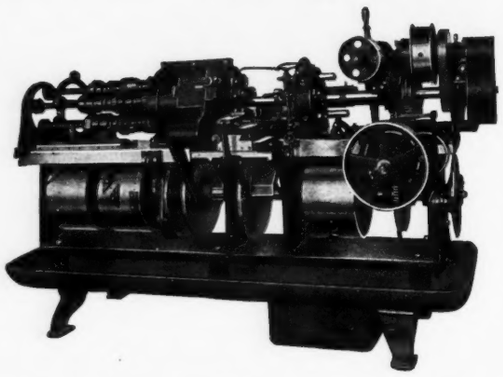
WALTHAM WATCH TOOL COMPANY, SPRINGFIELD, MASS., U.S.A.

The Universal Automatic Screw Machine

A Money-maker that will Quickly Earn its Cost.

Profitable

for any manufacturer who uses large quantities of metal parts.



Practical

and strong enough for almost every class of work milled from the solid bar.

Do You Want Bigger Profits?

Then the "Universal Automatic" is a necessity. Absolutely simple design and construction, does the work of a score of machines in an almost incredibly short time and bears the strain of the heaviest cuts without spring or binding. We have collected data on economical production of small metal parts, steel, iron or brass—any shape. This information is always at your service. *May we send it?*

THE UNIVERSAL MACHINE SCREW CO., Hartford, Conn.

DOMESTIC AGENTS: Prentiss Tool & Supply Co., New York, Boston, Buffalo. Brown & Zortman Machinery Co., Pittsburg, Pa. Niles-Bement-Pond Co., Chicago, Ill.

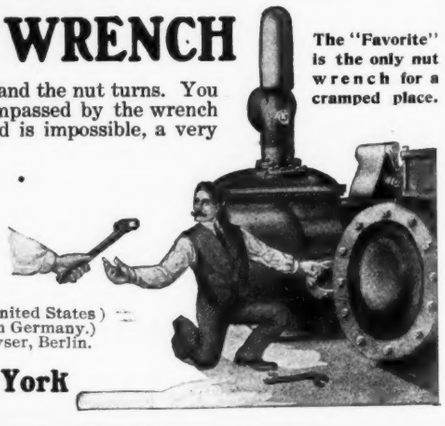
With THE FAVORITE REVERSIBLE RATCHET WRENCH

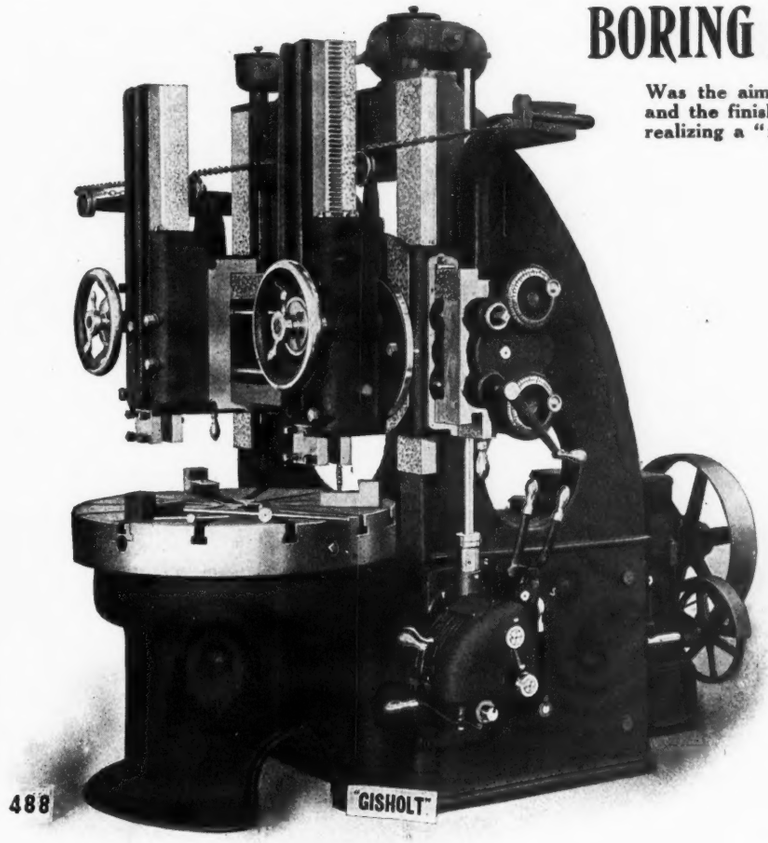
only a slight movement is necessary to enable the ratchet to catch one tooth and the nut turns. You are not bothered to catch a fresh hold at each turn, for the nut being encompassed by the wrench head does not leave it until the nut is seated or removed, slipping the hold is impossible, a very important matter when working in an awkward place. It is not only a trouble saver where other wrenches won't work, but wherever nuts are to be turned it has all ordinary wrenches skinned a mile.

"Favorite" (Registered trade mark in United States)
"Greentweed" (Registered trade mark in Germany.)
Selling Agent for Germany: Arthur Kayser, Berlin.

Greene, Tweed & Co., 109 Duane St., New York
Sole Manufacturers

The "Favorite" is the only nut wrench for a cramped place.





BORING MILL PERFECTION

Was the aim in designing Gisholt Boring Mills, and the finished machines come pretty close to realizing a "mechanical ideal."

Strength, simplicity and ease of operation are fundamental factors of the Gisholt mills. On all mills over 36-inch size the head-stock is of the friction, back-geared type, giving the operator instant control of work and table. Micrometer index dials reading to .001" are on all feeds. All gears are encased. Friction safety device prevents accident through careless handling. Feed tripping device automatically trips the feed at any pre-determined point. Operating levers are located on both sides of the machine.

Weight and rigidity to withstand the heavy strains of high speed steels are assured, but the machines are neither cumbersome nor needlessly massive.

We shall be glad to go into details if you will write us your needs.

GISHOLT MACHINE CO.

Works: **Madison, Wis.,** and **Warren, Pa.**

GISHOLT

General Offices:
1316 Washington Ave.
MADISON, WIS.

New York Office: Fulton Building, 50 Church Street

WE MAKE IT

Write for catalog

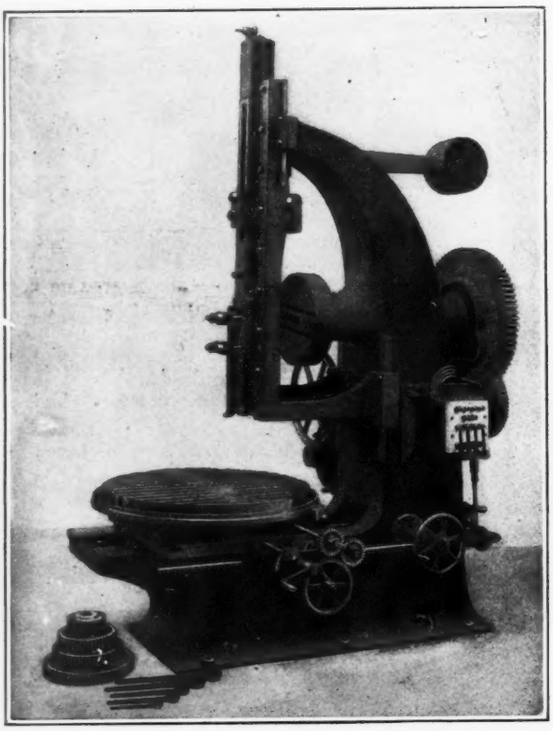
RACK

Pacific Tool & Supply Co.
San Francisco, Cal.

Hall & Pickles
64 Port St., Manchester, Eng.

Seattle Hardware Co.
Seattle, Washington

William Sellers & Co., Incorp., Philadelphia, Pa.



LABOR SAVING MACHINE TOOLS

Our **Slotting Machines** embody the most valuable features such tools should possess—viz.: stability, accuracy and convenience of manipulation—hence the largest and best product in a given time.

Our regular standard sizes are:

9″	stroke,	to slot	to centre of	36″	diameter.
10½″	“	“	“	42″	“
12″	“	“	“	48″	“
16″	“	“	“	60″	“
20″	“	“	“	72″	“

We have supplied more than 125 Slotters of various sizes to the Baldwin Locomotive Works in the past 11 years.

Catalogue No. 900

Satisfactory Service is the Record of “Walcott” 20-inch Crank Shapers.

Very powerful, compactly built, convenient and rapid producers. Have the strongest ram ever designed for a crank shaper, and driving gear of unusual strength.

Quick return; eight cutting speeds for each length of stroke; original feed mechanism equipped with safety device. Fitted with all improvements.

New catalog of Lathes and Shapers on request.

Walcott & Wood Machine Tool Co.

Succeeding
GEO. D. WALCOTT & SON

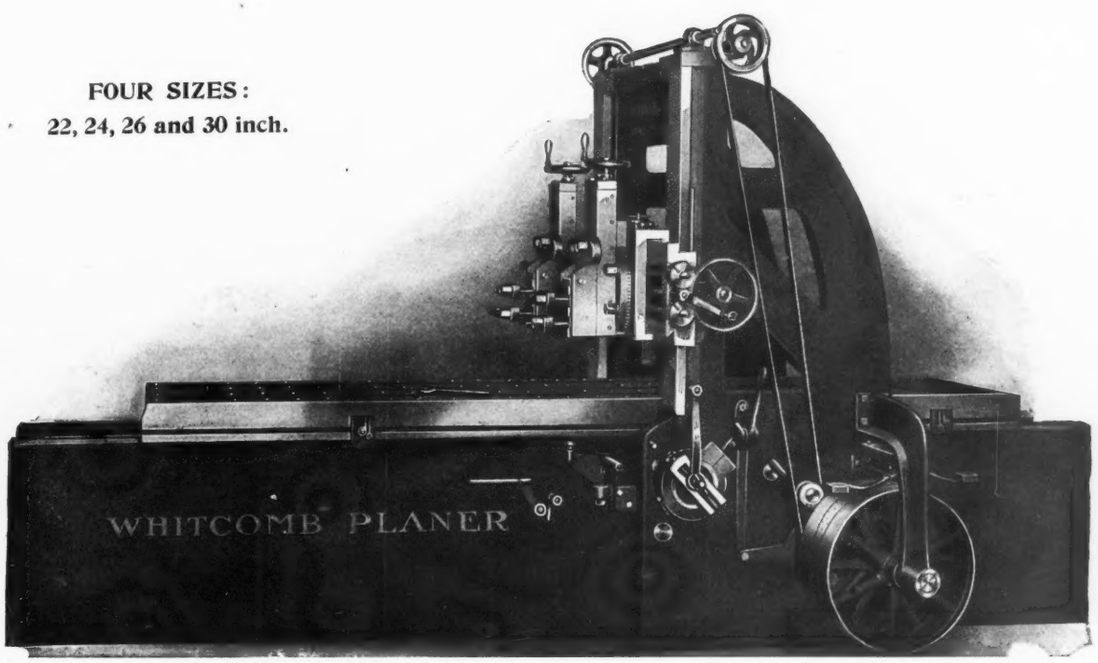
JACKSON, MICH.

AGENTS: Hill, Clarke & Co., Boston, New York, Philadelphia, Cleveland and Chicago. Chas. G. Smith Co., Pittsburg, Pa. Smith-Booth-Usher Co., Los Angeles, Cal. W. R. Colcord Machinery Co., St. Louis. Vonnegut Hardware Co., Indianapolis, Ind.

FOREIGN AGENTS: Fenwick Freres & Co., Paris, France. Buck & Hickman, Ltd., London, England.

You Can Raise the Speed Limit with Second Belt Drive Planers

FOUR SIZES:
22, 24, 26 and 30 inch.



Speeds that would ruin old style machines are regular with the Second Belt Drive.

They are powerful and rapid, consuming less power than full geared planers, with a considerably greater output.

Softening the cutting action of high speed steel tools, running without jar or shock, and almost without noise, makes an appreciable difference in favor of quality results.

The prompt reverse, so arranged that little backlash can develop, combined with simplicity of construction reduces wear and tear, liability to accident and adds to operating convenience.

Ask us for the Planer Catalog, also a full description of New Model High Speed Engine Lathes.

WHITCOMB-BLAISDELL MACHINE TOOL CO.

WORCESTER, MASS., U. S. A.

AGENTS: Hill, Clarke & Co., Boston, Chicago and Cleveland, O. Vandyck Churchill & Co., New York and Philadelphia. Thomas & Lowe Machinery Co., Providence, R. I. C. H. Wood Co., Syracuse, N. Y. E. L. Essley Machinery Co., (Planers), Chicago, Ill. Marshall & Huschart Machinery Co., St. Louis, Mo. J. L. Osgood, Buffalo, N. Y. Perine Machinery Co., Seattle, Wash. Compressed Air Machinery Co., San Francisco, Cal. Motch & Merryweather Machinery Co., Pittsburg, Pa. Zimmerman-Wells-Brown Co., Portland, Ore. Smith-Booth-Usher Co., Los Angeles, Cal. C. W. Burton, Griffiths & Co., London, England. Fenwick Freres & Co., Paris, France. Ludw. Loewe & Co., Berlin, Germany. De Fries & Co., Dusseldorf, Germany. Wilh. Sonesson & Co., Malmo, Stockholm, Gothenburg, for Sweden. Aktieselskabet, Wilh. Sonesson & Co., Copenhagen City and Freeport, for Denmark, Norway and Finland. Van Rietschoten & Houwens, Rotterdam, Holland. Williams & Wilson, Montreal, Canada. A. R. Williams Machinery Co., Toronto, Canada.

"MORSE CHUCKS"

STETSON PATENT DRILL CHUCK.

This chuck is strong and of heavy construction. The jaws are controlled by separate drivers and are guided in that part of the chuck which is attached to the driving spindle. This arrangement gives increased strength to the chuck.

The threaded and working parts of the Chuck are covered, and thereby protected from injury and dirt.

No. 2 Holds from 0 to 3/8 inch diameter.
No. 3 Holds from 1/16 to 1/2 inch diameter.
No. 4 Holds from 1/16 to 5/8 inch diameter.

These Chucks are so designed that a hole can be drilled through the center if desired.

No. 2 will permit of a hole 1/4 inch in diameter.

Nos. 3 and 4 will permit of a hole 3/8 inch in diameter.

With Chuck No. 2 is furnished a spanner wrench, illustrated below.

These wrenches are of steel, drop forged, finished and case hardened.

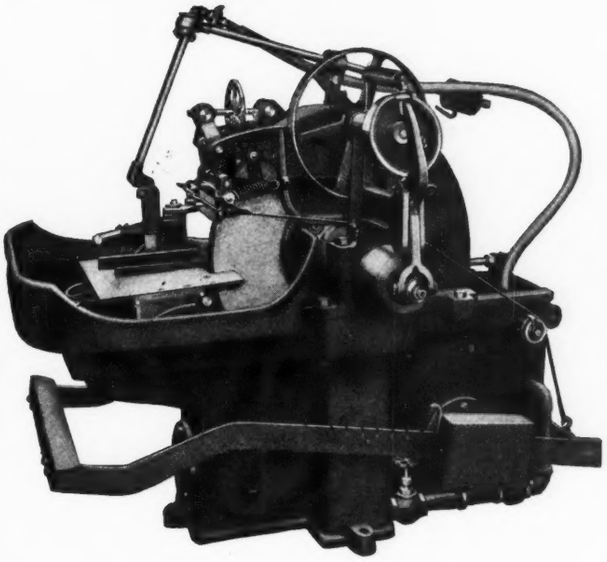
With Chucks Nos. 3 and 4, instead of a spanner wrench there is furnished a special pin used in tightening and for rapid adjustment.

ARBORS FITTING THESE CHUCKS

Morse Twist Drill & Machine Company

NEW BEDFORD, MASS., U. S. A.

Taylor Universal Tool Grinder



The pressure necessary to hold the tool against the wheel is automatically maintained by means of an adjustable counterweight, which, together with the oscillating motion of the wheel and method of moving the tool-holder, permits free access of water to the flat surface of the tool during the operation of grinding, and eliminates any possibility of the tool conforming to the shape of the wheel in any one position so as to cause injury by heating.

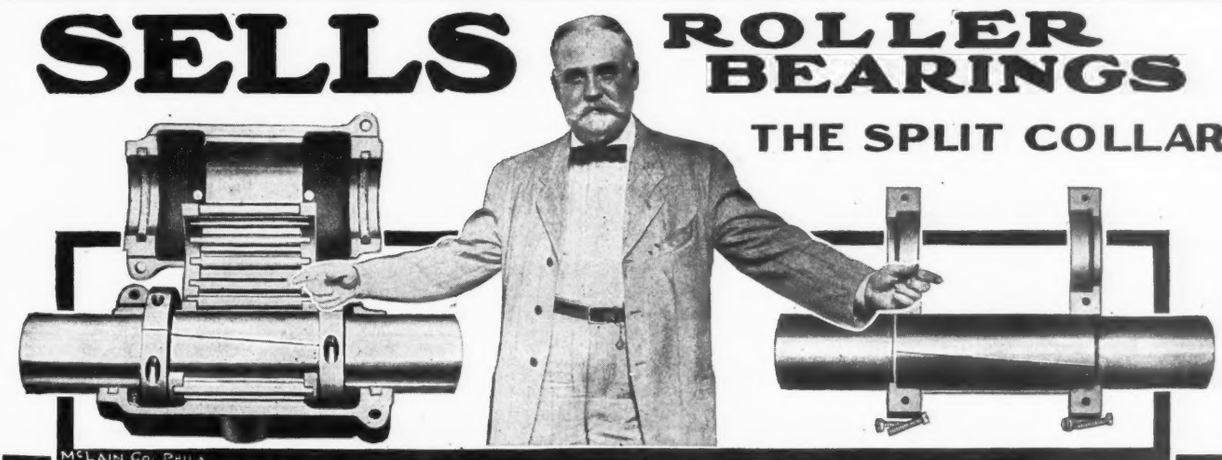
Treatise on Forging and Grinding mailed upon request.

The Tabor Manufacturing Company

18th and Hamilton Streets **Philadelphia, Pa.**

SELLS ROLLER BEARINGS

THE SPLIT COLLAR



McLAIN Co. PHILA

ONE OF THE GREATEST SELLS ADVANTAGES

The primary purpose of these split collars is to clamp the steel split bushings, on which rollers bear, to the shaft.

At the same time, however, they serve another very great purpose in forming a rotating surface against which ends of roller structure run. These collars being clamped to the shaft rotate at about three times greater speed than the roller structure itself, therefore they materially aid the latter rather than retard it, as do the usual methods of construction.

These collars are only one of the features which make it possible to save 50 to 65% friction with Sells Roller Bearings.

Here are the other features:—

(1) They are universal in adaptation (any Sells bearing can be fitted to any hanger, post hanger or pillow block, of a corresponding size.)

(2) Split throughout (applied as easily as a split pulley.)

(3) Shaft is protected from all wear by steel split bushings.

(4) Can be bushed to fit different diameters of shafts.

(5) All end thrust is eliminated (Sells is full floating type.)

(6) Sells has SELF-CONTAINED ROLLER STRUCTURE, eliminating all friction between rolls and insuring that rolls will run parallel with box at all times.

(7) Sells cost 50% less than any other roller bearings and can be fitted to every hanger, post hanger or pillow block in your plant without the expense of a single detail of new equipment.

NOW IF YOU WANT TO BE SURE how much good money these Sells Roller Bearings can save for you, sign the coupon attached hereto RIGHT NOW and mail to us—by return mail we'll send you the facts.

Will you send it right now?

Manufactured by

ROYERSFORD FOUNDRY AND MACHINE CO., Inc.

Manufacturers of Power Transmission Machinery, and Punching and Shearing Machines.

54 North 5th Street, PHILADELPHIA, PA.

COUPON

Royersford Foundry and Machine Co., Inc.
Philadelphia, Pa.

Gentlemen:—Replying to your ad. in MACHINERY, send me booklet and all information regarding Sells Roller Bearings.

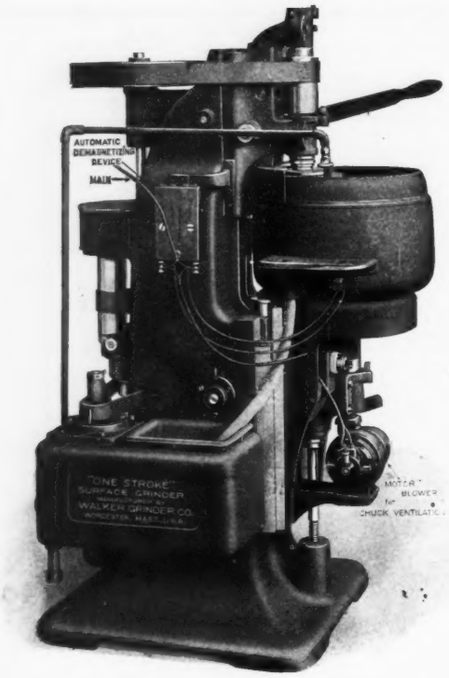
Name.....

Firm.....

Firm address.....

Business.....

Bearings now in use.....



THE **WALKER** SINGLE STROKE SURFACE GRINDER FOR WET AND DRY GRINDING. IT HAS THE MOST RIGID DESIGN POSSIBLE. THE GRINDING WHEEL IS BROUGHT DOWN WITH A LEVER AGAINST A POSITIVE STOP. THERE IS A COUNTERWEIGHTED WHEEL SLIDE, VERTICAL FEED IN AN UPWARD DIRECTION ELIMINATING SLACK MOTION. OPERATION IS THE ACME OF SIMPLICITY. IT IS THE MOST RAPID GRINDER IN THE WORLD.

Write us at once for special circular.

SOLE AGENTS

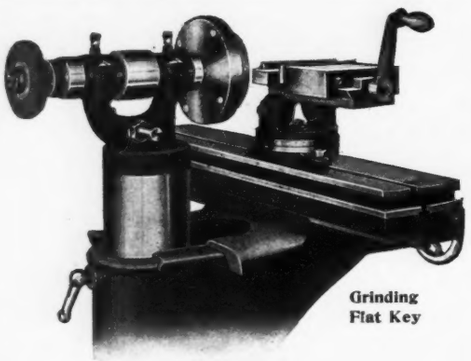
MANNING, MAXWELL & MOORE

INCORPORATED

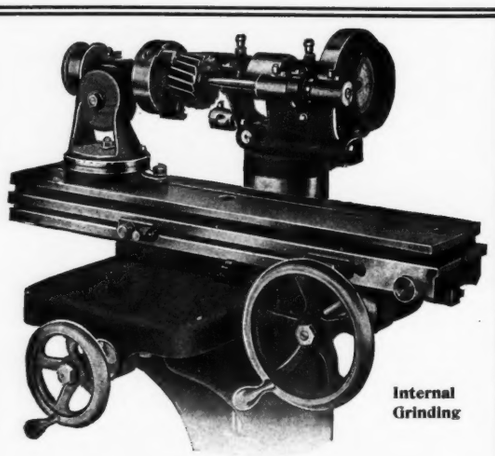
85-87-89 Liberty Street, New York

MACHINE SHOP AND FOUNDRY EQUIPMENT OF EVERY DESCRIPTION

111-115 No. Canal St. CHICAGO
Monadnock Bldg. SAN FRANCISCO
721 Arch St, PHILADELPHIA
Candler Bldg. ATLANTA
45 Oliver St. BOSTON
Traction Terminal Bldg. INDIANAPOLIS
Frisco Bldg. ST. LOUIS
White Bldg. BUFFALO
Park Bldg. PITTSBURG
Majestic Bldg. DETROIT
Merrill Bldg. MILWAUKEE
1262 Ontario St CLEVELAND
Yokohama JAPAN

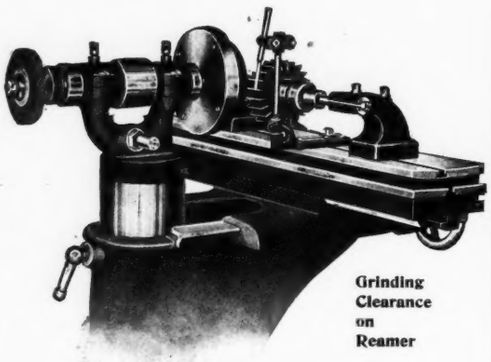


Grinding Flat Key



Internal Grinding

Sharpening Butt Mill having Taper Shank



Grinding Clearance on Reamer

Do all your Grinding on one machine —The Greenfield Universal Grinder

It is the grinder for tool sharpening of any kind.

Send for complete Catalog today.

Greenfield Machine Co., Greenfield, Mass.

A New Catalog

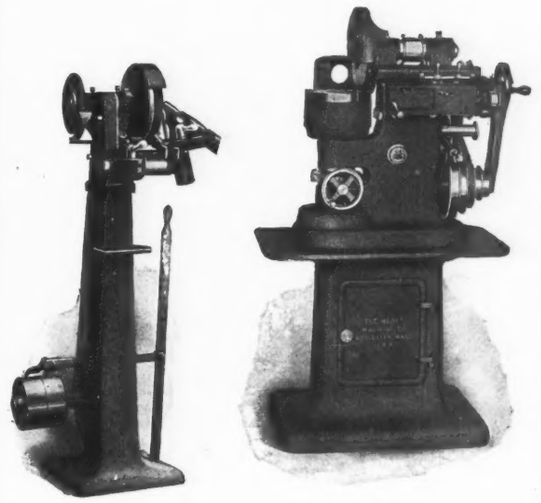
Covering all the different lines of grinding machines we manufacture has just been received from the printer, and we would be pleased to send you a copy without charge if you will furnish us with the address.

The Heald Machine Co.

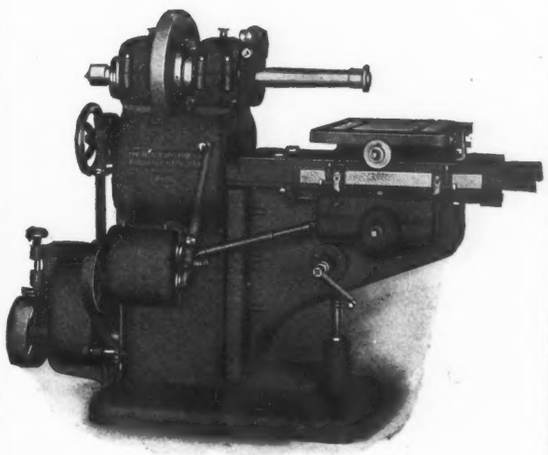
20 New Bond Street

WORCESTER, MASS., U.S.A.

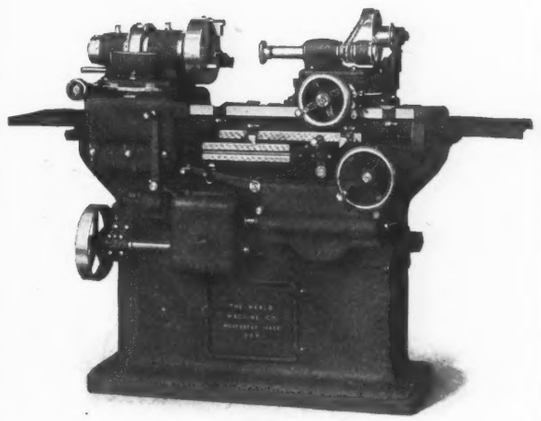
AGENTS:—Prentiss Tool and Supply Co., New York, Boston, Syracuse, Buffalo. Vandyck-Churchill Co., Philadelphia and Pittsburg. The Motch & Merryweather Machinery Co., Cleveland, Cincinnati, Detroit. Vonnegut Hardware Co., Indianapolis, Ind. Hill, Clarke & Co., Chicago, Ill. Chas. Churchill & Co., London, England. Fenwick Freres & Co., Paris, France; Belgium and Italy. Ludw. Loewe & Co., Berlin, Germany; Austria, Russia and Holland. Wilh. Sonesson & Co., Malmo, Sweden, Denmark and Norway.



Drill Grinder Ring Grinder



Cylinder Grinder



Internal Grinder

ABRASIVE

ABRASIVE FAST GRINDING WHEELS

Are preferred for General Rough Grinding among the operators at a large plant producing Manganese Steel Frogs and Crossings because they don't *merely* grind—they "cut"—cut fast and are durable.

Another point—they don't become smooth or slick. They always have a sharp, clean (free) cutting surface that rips off the surplus without causing the workmen undue effort.

Even the bond that holds the particles together has cutting properties.

Every "Abrasive" Wheel is turned, trued and tested for safety and guaranteed satisfactory.

Try them on your grinding operation.

ABRASIVE MATERIAL COMPANY, PHILADELPHIA, PA., U. S. A.

FOREIGN AGENTS—E. Sonnenthal, Jr., Berlin, Cologne and Vienna. Wilh. Sonesson & Co., Malmo and Copenhagen. Glaenzer, Perreaud & Thomine, Paris, France. R. d'Aulignac, Barcelona, Spain. Spliethoff, Beeuwkes & Co., Rotterdam, Holland. R. S. Stokvis & Fils, Brussels, Belgium. Alfred Herbert, Ltd., Milan, Italy. Donnell & Palmer, Buenos Aires, Argentina.

WE ALSO MAKE

Speed Lathes.

Lathes with Turrets, Cross Slides, Collet Chucks, etc.

Small Screw Machines.

Tapping and Threading Machines.

Tool Holders, etc.

A FEW DON'TS

DON'T wait for your tool to be ground.

DON'T stop production on expensive machines because your grinders are busy on other work.

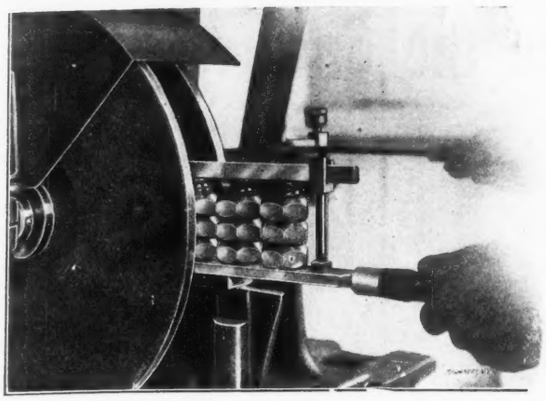
DON'T think you have got to have a full universal equipment for every special job that you would like a separate grinder for, and so keep it always set up for that work.

DON'T imagine that a tool grinder costs too much money because it

DON'T if it's a WELLS.

DON'T delay. We have just completed a large lot of these machines and can ship immediately if ordered NOW.

F. E. WELLS & SON COMPANY
Wells
GREENFIELD, MASS. U.S.A.



One Besly Grinder with unskilled operator Displaces Ten Milling Machines and Reduces Cost Nearly Ninety Percent.

Brass Hexagon Nuts. 1⅝ in. O. D. by ⅝ in. wide.
Stock removed—Enough to clean up, about 1/64 in. from each surface.
Accuracy—to size within 0.005 in.

Machine—No. 26-18 Besly Grinder with Besly Nut Grinding Fixture (Patented August 14, 1906), holding nine nuts at a time.
Circle—No. 2340, Grain No. 36 Helmet Spiral Circle.
Time—640 nuts, 3840 surfaces, per hour.
Cost of circles—about TEN CENTS PER HOUR.
Former time on specially designed milling machines, 65 nuts per hour.

Report on finishing six sides of Hexagon Brass Nuts from rough castings, after the nuts have been machined, bored, tapped and faced, in fact, finished all over except on the sides.

Outside diameter of nuts	1 5/32 in.	1⅝ in.	2¼ in.	3⅛ in.
Width of nuts	⅝ in.	⅝ in.	⅞ in.	⅞ in.
Nuts finished on sides, per hour	*1,000	640	400	225
Besly Nut Grinding Fixture holding following number of nuts	24	9	6	4
Formula number of Helmet Spiral Circles used.	2,340	2,340	2,330	5,110

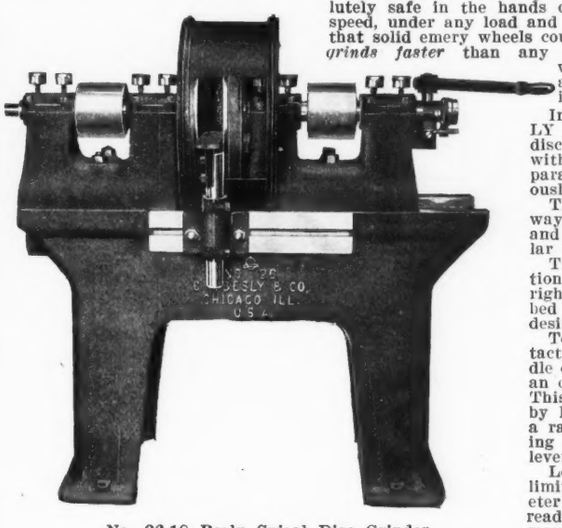
*CAN YOU IMAGINE ONE OPERATOR FINISHING FROM THE ROUGH, 6,000 METAL SURFACES PER HOUR? *Think that over.*

The BESLY GRINDER is the youngest member of the machine tool family and one of the most useful tools known to machine shop practice.

Grinding is done by emery (or other abrasive) cloth sheets, called circles, glued to the faces of steel disc wheels. When the circles become worn, they are torn off the steel wheels and new circles glued and pressed on.

The BESLY GRINDER is used chiefly for making, perfecting and finishing flat surfaces of metal. It can be *operated by unskilled labor,* and work for which it is adapted is done in a fraction of the time required by the lathe, planer, shaper, milling machine, file or any other type of surface grinder.

The BESLY GRINDER is the only machine tool known which turns out accurate, finished work without rigidly chucking same. To remove stock without rigidly clamping the work is a fundamental principle in disc grinding practice. It reduces cost, and is one of the *great advantages the BESLY GRINDER holds over all other machine tools and surface grinders.*



No. 26-18 Besly Spiral Disc Grinder
Code word "ZEND"

The BESLY Helmet Spiral Steel Disc Wheel is absolutely safe in the hands of unskilled labor, at any speed, under any load and under heavy side pressure that solid emery wheels could not stand. Further, it *grinds faster* than any other type of grinding wheel. This is not merely an advertising statement; it is an established fact.

In this double spindle BESLY GRINDER two grinding discs are brought in contact with the work, grinding two parallel surfaces simultaneously.

The Heads are mounted on ways planed on bed casting and clamped in position similar to tailstock of a lathe.

The Head to the left is stationary, but the one to the right can be moved along the bed and clamped to grind any desired length to 10 in.

To bring the discs in contact with the work, the spindle of the right-hand head has an endwise movement of 1 in. This movement is actuated by lever and pinion engaging a rack cut on the outer bearing bushing. This geared lever feed is patented.

Longitudinal movement is limited by adjustable micrometer stop screw, graduated to read to .001 in., so that work may be ground accurately to size and duplicated.

BESLY Helmet Spiral Disc Wheel with circle torn to show construction. The glue imbeds in spiral grooves in steel disc and acts as a driver to the circle, same as the tail of a lathe dog.

Helmet Spiral Circle—The abrasive is applied to the backing sheet in spiral ridges with intervening clearance spaces, because a corrugated or ribbed surface on the flat side of a disc will cut faster on flat work than a plain surface of abrasive.

Are You Up On Disc Grinding?

Charles H. Besly & Company

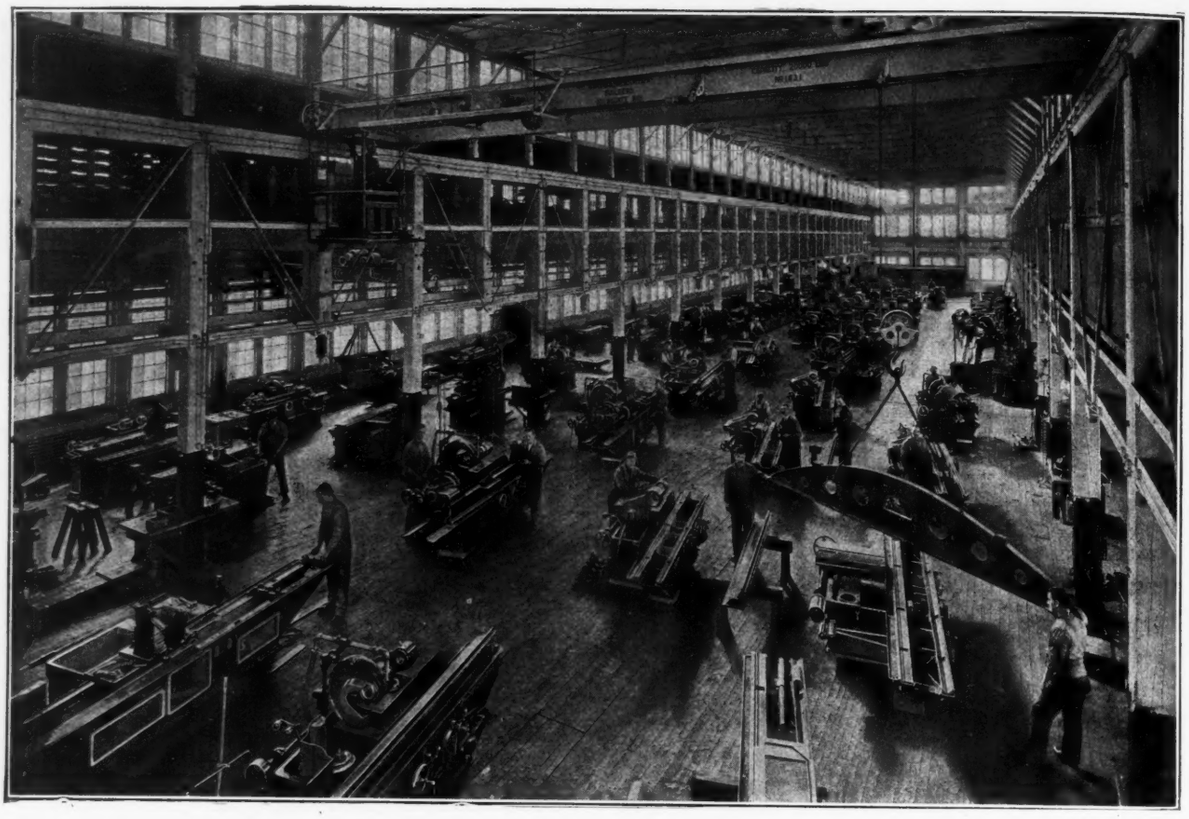
CHICAGO (Originators of Disc Grinders) **U. S. A.**

LARGEST MANUFACTURERS OF DISC GRINDERS IN THE WORLD

Cable Address, CHASBESLY, CHICAGO. A. B. C. and Lieber's Code.

FOREIGN AGENTS.—Buck & Hickman, Ltd., London, Birmingham, Manchester and Glasgow. Charles Churchill & Co., London, Birmingham, Manchester, Newcastle-on-Tyne and Glasgow. Schuchardt & Schutte, Berlin, Vienna, St. Petersburg, Stockholm, Copenhagen, Budapest, Prague and Shanghai. Alfred H. Schutte, Cologne, Paris, Brussels, Liege, Milan, Madrid, Bilbao and Barcelona. Ing. A. Baldini & C. Pontedera, Italy. Thomas Drysdale & Co., Buenos Ayres. John Danks & Co., Melbourne and Sydney.

Visit our Works and see the Care we Take



To Secure Good Results with

Norton Grinding Machines

See our system of *straight edges.*
See our *lining fixtures.*
See our system of *scraping.*
See our system of *inspection.*
See our system of *testing, etc.*

We Are Specialists With Special Equipment

AGENTS—
Vonnegut Hardware Co., Indianapolis.
Robinson, Cary & Sands Co., St. Paul and Duluth.
Manning, Maxwell & Moore, Pittsburg, St. Louis, Philadelphia, Atlanta.
Prentiss Tool & Supply Co., New York, Boston, Buffalo, Syracuse.
Motch & Merryweather Mchy. Co., Cleveland, Detroit and Cincinnati.
The Canadian Fairbanks Co., Montreal, Toronto, Vancouver.
Henshaw Bulkley & Co., San Francisco, Los Angeles.
Ludw. Loewe & Co., Ltd., London, Berlin, European Agents.
F. W. Horne, Yokohama, Japan.

Norton Grinding Company
Worcester, Mass.

Chicago Store: 11 North Jefferson Street.

N 102

THE CUTTING FACE OF A GRINDING WHEEL

has thousands of little tools cutting off little chips. It makes a big difference what these little tools are made of, just as it makes a big difference what quality of steel is used in making steel tools. It makes a big difference as to how each little tool holds its cutting edge.

A Norton wheel gets its good-cutting face from Alundum. Each little grain of Alundum that is working is a tool in perfect condition for good work.

Insist on a grinding wheel made of Alundum, just as you would insist on the best grade of steel for your steel tools.

INDIA OIL STONES

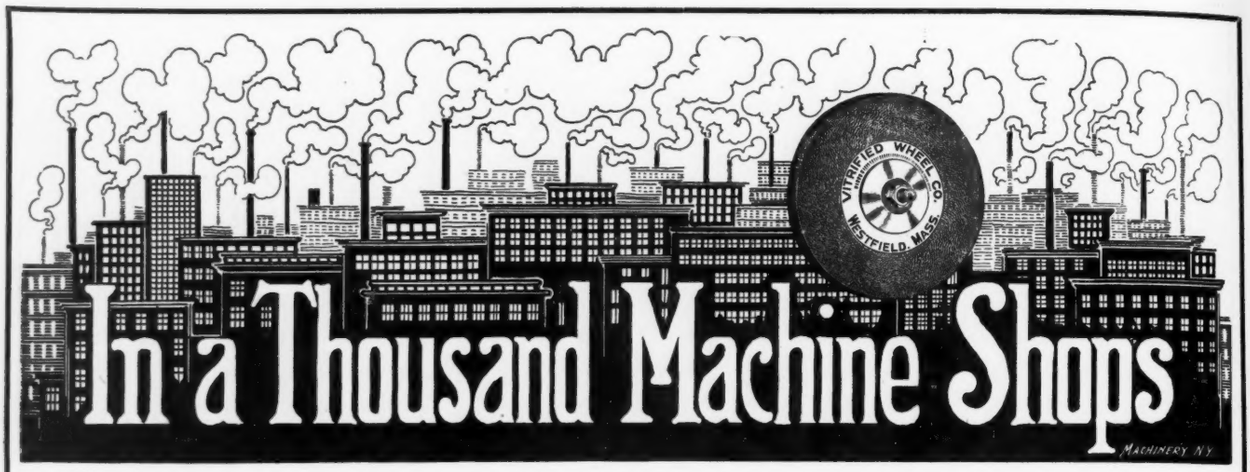
Every user of edged tools should have a list of India Oil Stone shapes and prices. The "India" cutting quality is recognized wherever tools are used. Made in 64 different shapes. Send for list to PIKE MANUFACTURING COMPANY, Pike, N. H., Sole Selling Agents for the India line.

NORTON COMPANY

WORCESTER, MASS., U. S. A.

New York	Chicago	Niagara Falls
50 Church St.	11 No. Jefferson St.	Alundum Plant

148



Factories and manufacturing establishments Vitrified Grinding Wheels are in constant use and giving exceptional satisfaction—is your plant in this list?

Vitrified Wheels are cool cutting at highest speeds, do not heat or draw the temper from work or tools, therefore, especially adapted for high speed steels. Free and easy cutting, they increase the workman's productive capacity. Profitable because they do their work well and without waste.

Vitrified Grinding Wheels

give the sharp, clean bite so essential in grinding work, are adapted for every class of work, are made from an almost pure Crystal Corundum and thoroughly tested before delivery.

Let us send the new book on Vitrified Wheels.

VITRIFIED WHEEL CO., Westfield, Mass.

The Bath Universal Grinder is the Practical Shop Grinder

It is neither convenient nor necessary to have a separate machine for each special class of grinding—floor space and capital are both absorbed by such extra tools—put in a Bath Universal and do all the work on one machine. The Bath is adapted for surface, cylindrical, internal, tool and cutter grinding; it is strong, rigid, accurate, easily operated and built for service.

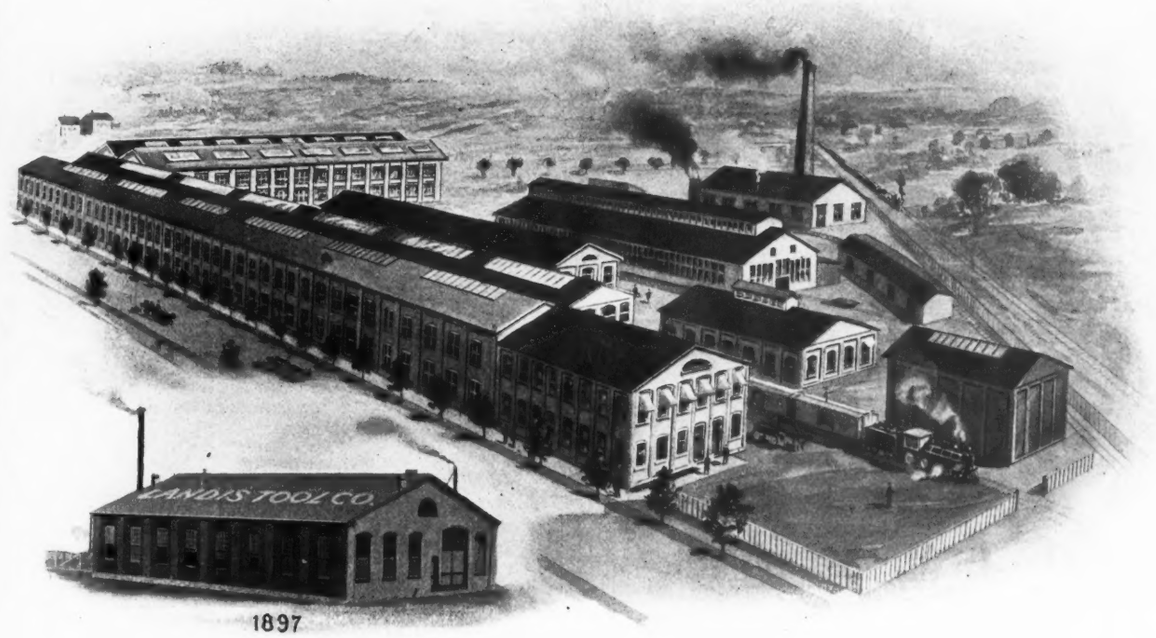
Our Catalogue will serve as an introduction if you are not already familiar with our machines.

The Bath Grinder Company, Fitchburg, Mass.

FOREIGN AGENTS: Japan, Alfred Herbert, 224 Yamashito-cha, Yokohama. Northern and Eastern Germany, Austria-Hungary, Sweden and Russia, Schuchardt & Schutte, Berlin, Vienna, Stockholm and St. Petersburg. Western and Southern Germany, Switzerland, Holland, Belgium, France, Spain and Italy, Alfred H. Schutte, Neumarkt 18, Cologne.

Where Landis Grinders are Built

A LITTLE STUDY IN EVOLUTION



The two buildings shown above mark the wonderful growth of a manufacturing business founded on the right basis and conducted on the highest and most up-to-date methods.

The Landis Plant is today the Largest in the World

Devoted exclusively to the building of Grinding Machines for Cylindrical and Conical Surfaces and is known in every country where machinery is employed.

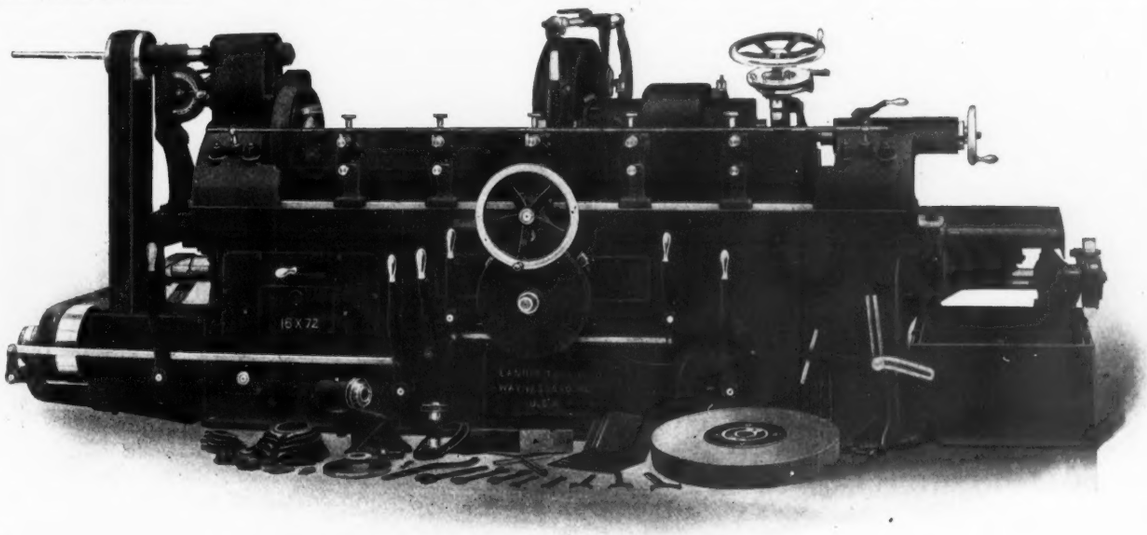
THE LANDIS LINE INCLUDES—Universal Grinding Machines, Plain Grinding Machines, Plain Grinding Machines with Gap, Crank Grinding Machines, Internal Grinding Machines, Cam Grinding Attachments—all built from improved designs, equipped with latest time and labor saving devices and conceded to be the most rigid, accurate and adaptable grinders on the market.

Complete Catalogue or special folders with samples of work sent on request.

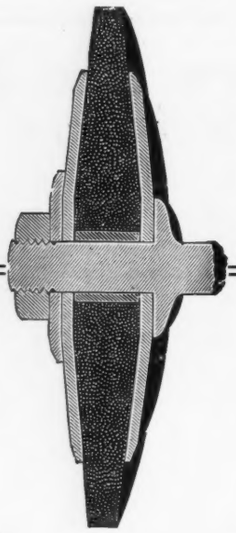
LANDIS TOOL COMPANY, Waynesboro, Pa., U.S.A.

New York Office, Fulton Building, 50 Church Street, Walter H. Foster & Co., Managers.

AGENTS—C. W Burton, Griffiths & Co., London and Glasgow. Schuchardt & Schutte, Berlin, Vienna, Stockholm, St. Petersburg, Copenhagen and Budapest. Alfred H. Schutte, Cologne, Brussels, Liege, Milan, Paris and Bilbao. A. R. Williams Machinery Co. Toronto. Williams & Wilson, Montreal, Canada.



A Modern Grinding Machine—Landis 16-in. x 72-in. Plain Grinder. Self-contained.



You Can Use Every Inch of a Safety Grinding Wheel

By simply changing to a smaller set of safety collars as the wheel wears away in use. By this method the wheel is held in place from the time it is put into service until it is entirely worn out.

The Safety Collar

also permits the wheels to be run at high speeds without danger of breaking and possible injury to your workmen.

Safety Collars are either sold or loaned free to users of our wheels.

We carry in stock a complete line of regular Safety, sectional, plain and special Corundum, Carbondite and Emery Wheels. Special shaped wheels for all standard makes of universal cutter, tool and knife grinding machines ready for immediate shipment.

Our Catalogue No. 6 is a complete reference book of Abrasive Wheels, Polishing and Grinding Machinery. Send for copy.

The Safety Emery Wheel Co.
Springfield, Ohio

J. R. Baxter & Co., Montreal, Canada. Alder & Eisenschitz, Milan. Pfeil & Co., London. V. Lowener & Co., Copenhagen. DeFries & Co., Act. Ges., Dusseldorf, Berlin, Wien and Paris.

American Corundum and Emery Wheels

are producing excellent results on these DIFFICULT GRINDING OPERATIONS.

Grinding frogs and switches, (open hearth and manganese steel).
Automatic surface grinding of brass and cast iron.
Grinding chilled iron rolls.
Finishing gun barrels.
Grinding cotton mill spindles.
Grinding aluminum castings.

American Grinding Wheels, used according to modern grinding practice, are producing **better results at lower ultimate costs** than any others made.

Let us prove this to you.

American Emery Wheel Works
Providence, R. I., U. S. A.

Fenwick Freres & Co., Paris, Brussels, Liege, Zurich, Genoa, Milan; Heinrich Dreyer, Berlin, Germany; Hans Schulze, Vienna and Brunn, Austria; A. B. V. Lowener, Stockholm, Sweden. V. Lowener, Copenhagen, Denmark. V. Lowener's Maskinforretning, Christiania, Norway. R. S. Stokvis & Zonen, Ltd., Rotterdam, Holland.

DISC GRINDERS and GARDNER GRINDERS are one and the same thing.

Specify **"Gardner Grinder Finish"** on your drawings and a large saving in **Time** and **Metal** is assured.

GARDNER MACHINE CO., Beloit, Wis.

CARBORUNDUM

FASTER AND BETTER

IN grinding large steel dies for stamping out buckets and coal hods, Carborundum was tested out in competition with the best grinding wheels that could be found of other makes. Carborundum ground one die every fifteen minutes—It did not heat the die—It held up well on the corners and did not throw chunks or raise dust—

The best of the other wheels took 30 to 40 minutes for each die—It threw chunks and did not hold up on corners—It also raised so much dust that the operator could not finish a die without taking fresh air. Carborundum not only worked twice as fast, but it held up better, lasted longer and was clean. It will do the same thing in your grinding shop.

THE CARBORUNDUM COMPANY, Niagara Falls, N. Y.

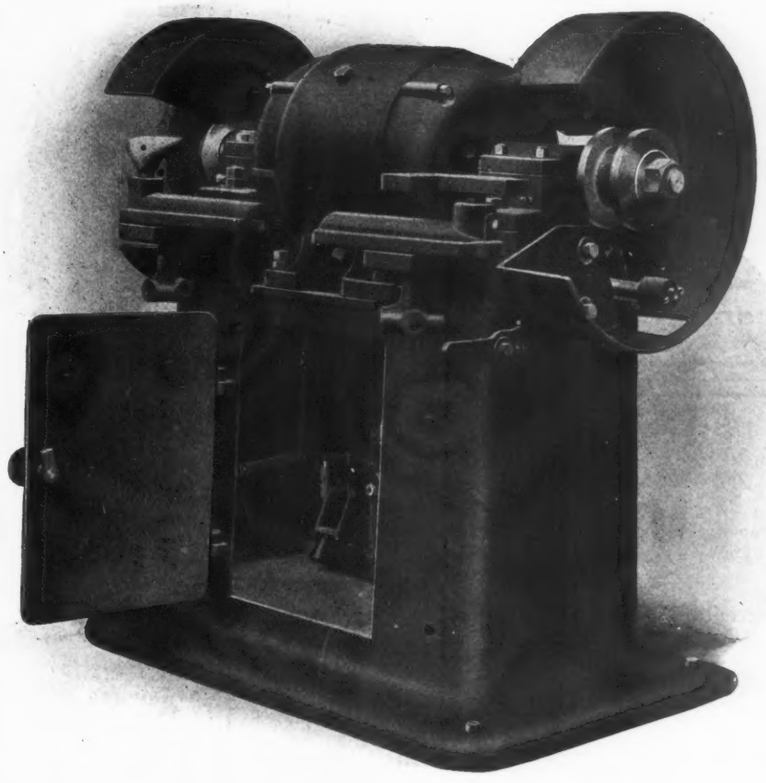
The Ransom Patent Speed Controller Applied to Ransom Motor Driven Dry Grinders

Makes an A-1 combination of economy, convenience and efficiency.

Gives the operator complete control of speed variation. Keeps the machine running at correct speed as the wheel wears down. Assures the maximum production at all times without power losses.

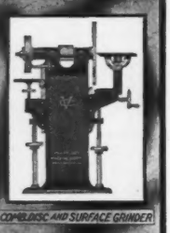
Adapted for any direct current grinder.

Ask us for complete details.



RANSOM MANUFACTURING CO., Oshkosh, Wis.

GRINDER LINE


COMB. DISC AND SURFACE GRINDER

No. 12 GRINDER

COMB. WET AND DRY GRINDER

The Valley City Combination Disc and Surface Grinder

is an especially advantageous machine for the pattern shop and for all kinds of tool and surface grinding. The very substantial construction, body of machine one solid casting, eliminates vibration and contributes to accurate product. All conveniences—rapid adjusting screws, tilting table, micrometer adjustment for upper table, rest for tool grinding—a complete and efficient machine.

Full line includes Wet and Dry Grinders, Combination Machines, Buffing and Polishing Machines.

Send for Catalogue.

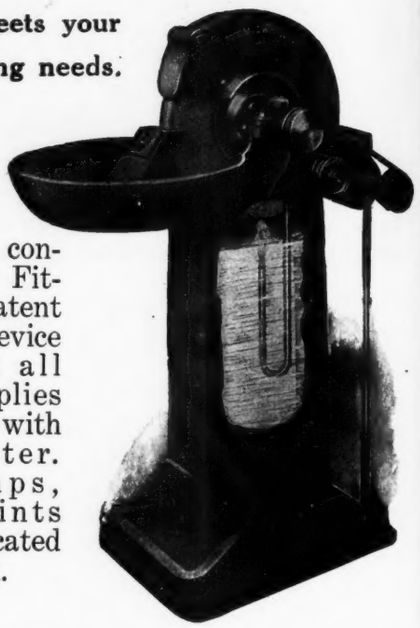
Valley City Machine Works
Grand Rapids, Michigan

No. 18 BUFFER

OUR LEADERS

The Milwaukee Wet Tool Grinder

Exactly meets your tool-grinding needs.



Simple in design, strong and substantial in construction. Fitted with Patent Air Jet Device which at all times supplies the wheel with *clean* water. No pumps, packed joints or complicated mechanism.

A first-class machine—ask for catalogue.

LUTTER & GIES, Milwaukee, Wis.

AGENTS—E. L. Essley Machinery Co., Chicago. O. L. Packard Machinery Co., Milwaukee.

You'll Have No Use for Diamonds

After Trying the DIAMO-CARBO EMERY WHEEL DRESSER

It is much cheaper than the Black Diamond, and far superior; never becomes dull, always keeps a sharp cutting edge to wheel, shapes the wheel as you want it shaped and leaves it better than any other method will.

No. 3—10' $3.50. No. 5—12' $4.00. Write for Booklet.

Desmond-Stephan Mfg. Co.
URBANA, OHIO

In Drill Grinding

Speed, simplicity and accuracy all demand the use of

NEW YANKEE Drill Grinders

They are in a class by themselves as to high quality and convenience, yet the cost is small.

Catalog free

SURFACE AND TOOL ROOM GRINDERS.

Wilmarth & Morman Co.
580 Canal St., Grand Rapids, Mich.

Agents for Great Britain: C. W. Burton, Griffiths & Co., London. Buck & Hickman, Ltd., London.

13-inch **Plain Cutter and Reamer** **12 and 14-inch**

LATHES GRINDERS DRILLS.

16-inch **Universal Tool and Cutter** **Sensitive**

We want your business. Remember! Let us hear from you.

The Miami Valley Machine Tool Company
843 Germantown St., Dayton, Ohio, U. S. A.

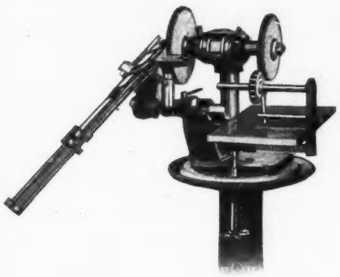
CUTTING ABILITY— SAFETY— SPEED

Factors that have placed Sterling Grinding Wheels as the first choice of experienced buyers. Uniform in quality. Made in all shapes and sizes and graded to meet every grinding need.

THE STERLING EMERY WHEEL MFG. CO. **Factories and Offices: TIFFIN, O., U. S. A.**

BRANCHES: New York House, 45 Vesey St. Chicago House, 553 West Washington St. San Francisco House, 139 Townsend St.

The Robinson Tool Grinder for Twist Drills and General Work

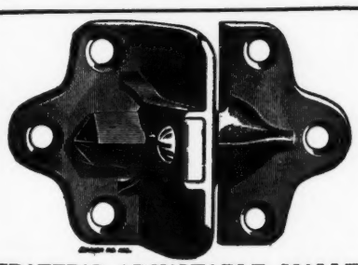


Any mechanic can grind twist drills theoretically correct on the Robinson Improved Grinder. Especially satisfactory on three and four flute drills.

Selected wheels and smooth, steady running insure the efficiency so necessary for fine tool grinding.

Combines many special features of larger, more costly machines. Moderate price. Write for details.

THE ROBINSON TOOL WORKS
Waterbury, Conn., U. S. A.



FRAZER'S ADJUSTABLE MALLEABLE IRON FLASK PIN

saves time, expense, and makes true castings. Quickly applied and easily adjusted.

Send for prices on our line of Pattern Makers' Specialties.

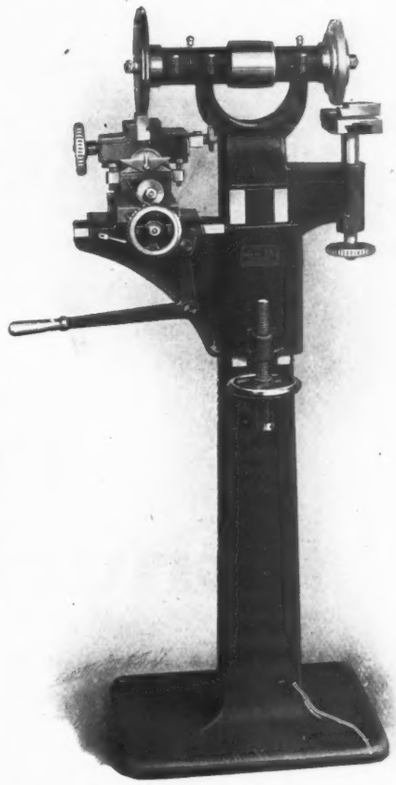
MILWAUKEE FOUNDRY SUPPLY CO.
Milwaukee, Wis.

FORGINGS
For Machinery Builders

We have Steam Hammers, Drop Hammers, Trip Hammers and Upsetters.

The Machinery Forging Co.
CLEVELAND, O.

The New Geometric Chaser or Die Grinder Insures Continued Accuracy.



That's the chief requirement of all screw-cutting tools. Correct grinding by hand is no easy matter and the Geometric Grinder is distinctly designed to overcome these difficulties and secure clean cutting dies quickly and economically, within any desired limit of tolerance.

For "touching up" or complete regrinding all makes of thread chasers, either stock or special, this machine is unequaled and a second wheel provides for ordinary tool grinding.

Universally mounted vise with adjustments for grinding to any radius, right or left hand, is part of the equipment.

Let us send the full description.

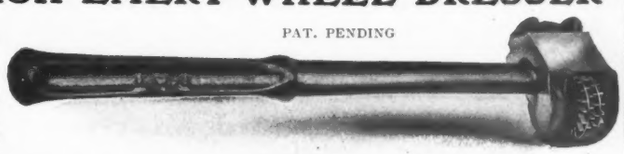
The Geometric Tool Co.
Westville Station, New Haven, Conn.

PACIFIC COAST AGENTS—The Compressed Air Machinery Co., San Francisco, Cal. FOREIGN AGENTS—Chas. Churchill & Co., Ltd., London, Birmingham, Manchester, Newcastle-on-Tyne. Alfred H. Schutte, Cologne, Brussels, Liege, Paris, Milan, Bilbao. Schuchardt & Schutte, Vienna, St. Petersburg, Stockholm, Berlin. Van Rietschoten & Houwens, Rotterdam, Holland.

MARBACH EMERY WHEEL DRESSER

Double Life
No Danger

PAT. PENDING



The best Wheel Dresser made. Safeguards the operator because the patent side handle keeps him out of the path of flying emery or pieces of the wheel in case of accident. Outwears several ordinary dressers, has two sets of cutter wheels, leverage is under easy control. Price $1.00—and nothing like it on the market at any price.

THE F. G. MARBACH CO., Medina, Ohio

Grinding Machines

Different Styles and Sizes for Floor and Bench.

EMERY WHEEL DRESSERS

No. 1 For Regular Shop Use

No. 2 For Large Wheels

These Dressers in connection with our Cutters make a most powerful and efficient tool, especially our No. 2 which is made proportionately larger and stronger for large wheels.

CUTTERS

We make the regular "Huntington" (pattern) Paragon Cutter and Roughing Cutters for Dresser No. 1, and the "Huntington" (pattern) and Roughing Cutters for Dresser No. 2.

Let us send you descriptive circular and prices.

GEO. H. CALDER, Lancaster, Pa., U. S. A.

The King Machine Tool Company.
CINCINNATI, OHIO, U. S. A.
VERTICAL TURRET BORING AND TURNING **MACHINES**

In this Age of Competition the Quality of Finish Talks—

That the most accurate surfaces, the most durable and reliable bearings, the best exterior finish are produced by grinding has long been conceded by experienced men—the lack was a machine possessing the efficiency and adaptability to economically meet all conditions.

The Bryant Chucking Grinder

fills this need exactly. It is built for general chucking, covers the whole field and is one of the most rapid and accurate producers of duplicate parts yet offered.

The multiple wheel feature permits internal, external and face grinding at one setting of the piece. Quality of work turned out is above criticism. The system of stops insures exact duplication of diameters and thicknesses, and reduces cost of assembling.

Save money and improve your product by installing "The Turret Lathe of the Grinding Art".

Catalogue and examples of work on request.

Bryant Chucking Grinder Company

Springfield, Vermont, U. S. A.

CARD TAPS

ARE THOROUGHBREDS

Some tools may run to the three-quarter post, but can't hold a lead to the finish—put your money on a Card Tap and get the purse.

The advantage of best material, accurate methods of manufacture, uniformity of pitch, good temper and staying qualities are back of every Card Tap.

It's "Card Taps" against the field, and when your dealer recommends a Card Screw Cutting Tool, you are getting an inside tip from a friend who really knows.

Catalogue and list of "past performances" on request.

S. W. CARD MFG. COMPANY

MANSFIELD, MASS., U. S. A.

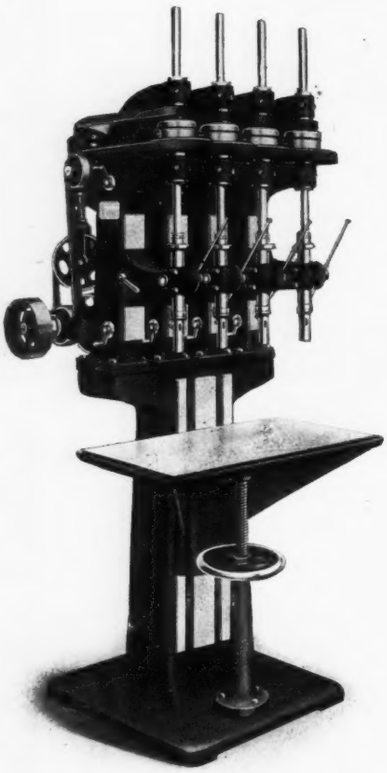
EUROPEAN AGENTS—Chas. Churchill & Co., London, Birmingham, Manchester and Glasgow; Markt & Co., Ltd., Paris; Fenwick Freres & Co., Milan; Ignacz Szekely, Budapest; V. Lowener, Stockholm, Copenhagen, Christiania; A. A. Kampfraath (Brussels), Ltd., Brussels; Hans Schulze, Vienna and Brunn, Austria.

A Long Lived Drill
AND A WORKER

QUICK CHANGE BALL BEARING ELMORE HIGH SPEED DRILL PRESSES

Quick Change Drill Press

One of the up-to-date, money-saving, labor-eliminating machines that is produced only once in a cycle of time. Built with ball bearings throughout, it gives long service with least attention, is compact, easily operated and covers a wide range of drilling.



The new patented belt drive combines all advantages without a loophole for wasted power. Four changes of speed, from 500 to 2050 R.P.M., are instantly effected while the machine is running and without the operator leaving his working position. Connection from pulleys on the driving shaft to pulleys on spindle is by an endless belt of unusual length which is never shifted—the speed changes being produced by the action of simple, cone type clutches interposed between pulleys of different diameters on drive shaft and spindle. Two conveniently located levers control the movement of these clutches, and are self-locking in all positions.

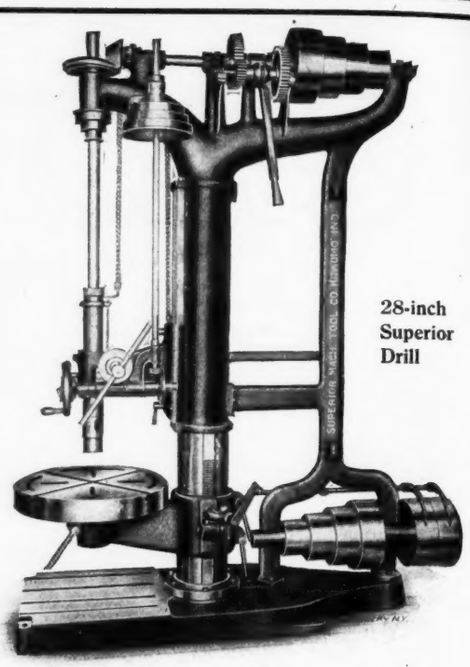
We shall be glad to enumerate further good points, if you will write us.

Single or Multiple Spindle Types.

The Dwight Slate Machine Co.

516 Asylum Street, HARTFORD, CONN.

DOMESTIC AGENTS—Manning, Maxwell & Moore, Inc., Chicago, Philadelphia, Boston, St. Louis, Pittsburg, Buffalo, Atlanta, Indianapolis, Detroit, Milwaukee, San Francisco, and W. M. Pattison Supply Co., Cleveland, Ohio.



28-inch Superior Drill

A Powerful Superior Drill

All up-to-date improvements, back gears, power feed, sliding head, etc., and every convenience for easy handling are combined in this machine.

Full specifications on request.

THE SUPERIOR MACHINE TOOL CO.
KOKOMO, INDIANA

Do You Drill Holes?
HOW MANY?

How much does the labor cost in a year's time?
How many hands on that kind of work?

We are doing one job in 4 hours on the

Avey Ball Bearing Drill Press

that formerly required 17 hours on a Standard "up-to-date" upright drill.

Even at the low rate of $4.00 a week, $208.00 a year, the same work would cost only $49.00 on the Avey—**Saving $159 00** on one drill. Higher rates show still greater savings.

If we save you even one-half your labor on all sizes straight through, **does the old drill press pay?**

Where do the dollars look best to you? In your profits—or in your payroll?

The Cincinnati Pulley Machinery Company
Cincinnati, Ohio

The Rockford Gang Drills and the Rockford Patented Geared Tapper

Make a "powerful good" combination for the shop or manufacturing plant. The 31-inch Gang Drill is simple, accurate, immensely powerful and wonderfully well designed. Arranged with suitable jigs it is particularly valuable for boring and tapping pump cylinders, and for boring and facing in rotary pump work. The reverse gear is disconnected by moving forward the lever on the right hand side, obviating the necessity for the operator to leave his position in front of the machine. Clutch connecting the feed is thrown out when the machine is placed in a neutral position, also stopping the spindle instantly.

THE ROCKFORD DRILLING MACHINE Co. ROCKFORD ILL U.S.A.

The **Patented Geared Tapper,** being a part of the machine, is always in place and ready for work, or can be lifted out of mesh in a few seconds' time. Simple, convenient and a labor saver.

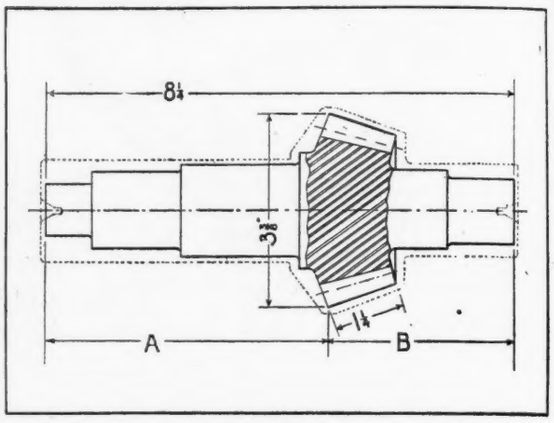
Write for the full description.

Rockford Drilling Machine Co.

ROCKFORD, ILL., U. S. A.

Edgar Bloxham, Agent for France, Italy and Belgium; Thomas McPherson & Son, Melbourne; Alfred H. Schutte, Agent for Western Germany, Switzerland, Spain and Portugal; R. S. Stokvis & Zonen, Ltd., Rotterdam, Agents for Holland and the Dutch Colonies.

Machining Automobile Main Driving Pinion on a 14" FAY AUTOMATIC LATHE in Two Operations



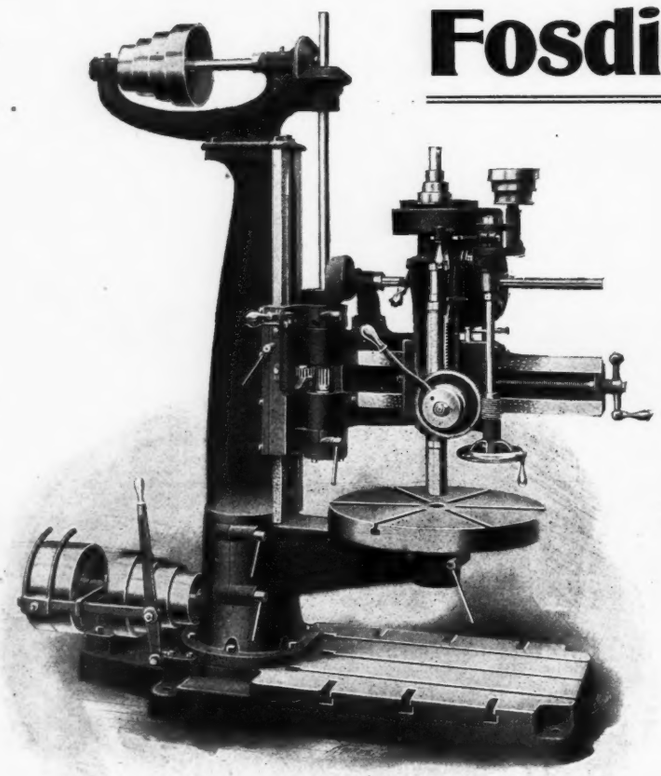
FIRST OPERATION

Work held on centers.
Back tool roughs back end of teeth.
Carriage turns diameters shown between dimension lines A, and finish turns back end of teeth.

Two lathes, attended by one man, produce 60 pieces per day.

FAY MACHINE TOOL COMPANY, Philadelphia, Pa.

FOREIGN AGENTS: Great Britain, C. W. Burton, Griffiths & Co., Ludgate Square, Ludgate Hill, London, E. C.; Germany, Switzerland and Austria-Hungary, Heinrich Dreyer, Kaiser Wilhelmstrasse 1, Berlin, C 2; France and Italy, Edgar Bloxham, 12 Rue de Delta (IXe), Paris; Belgium and Holland, Stokvis & Zonen, Rotterdam.



Fosdick Radials

Improved machines that meet your drilling and tapping requirements—every day or special needs—with up-to-date directness, accuracy and economy.

Back gears and tapping attachment are located on the head. The arm swings on ball bearings. A rack and pinion facilitate movement of the head along the arm. Every labor-saving device that has practical value incorporated.

The operator appreciates a Fosdick for its simple and easy operation. The owner approves it for its cost reducing and work producing qualities.

The catalogue gives all the details.

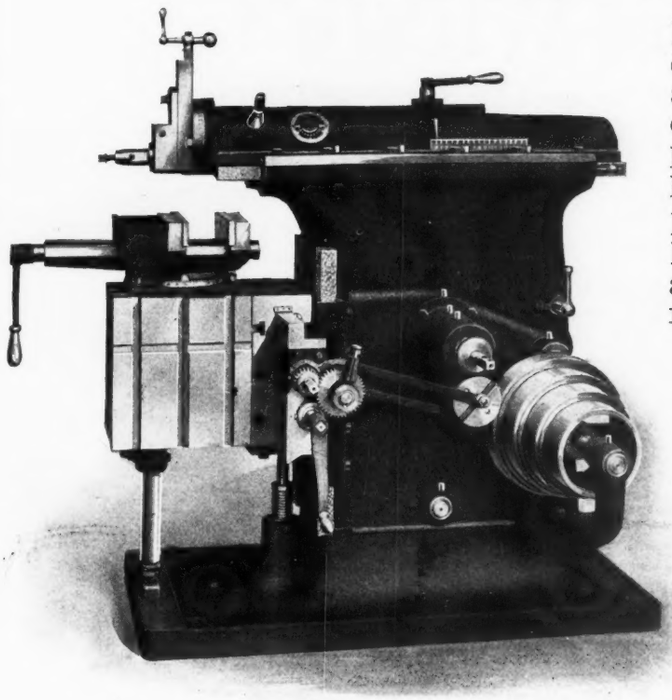
The Fosdick Machine Tool Co.

CINCINNATI, O., U. S. A.

FOREIGN AGENTS: R. S. Stokvis & Zonen, Rotterdam, Holland. Fenwick Freres & Co., Paris, France. Ludw. Loewe & Co., Berlin, Germany. Adolfo B. Horn, Havana, Cuba. Bevan & Edwards, Propty. Ltd., Melbourne, Australia. C. W. Burton, Griffiths & Co., London, England.

ROCKFORD CRANK SHAPERS

For Smooth Mechanical Performance



16' Back Geared Crank Shaper—Four Sizes

Meet "today's" demands with the efficiency of "tomorrow's" equipment, anticipating the need for greater capacity with a shaper for doing the possible near-future as well as the present actual work.

Noted for high speeds and heavy cuts, Rockford Shapers are equipped to best advantage, and with every convenient feature for rapid and easy operation. They will plane to an exact line and have an accurate hair-breadth control.

The Catalogue will interest you.

ROCKFORD SHAPERS
14, 16, 20 and 24" stroke.

ROCKFORD PLANERS
24, 28, 32 and 36" sizes.

ROCKFORD MACHINE TOOL CO., Rockford, Ill.

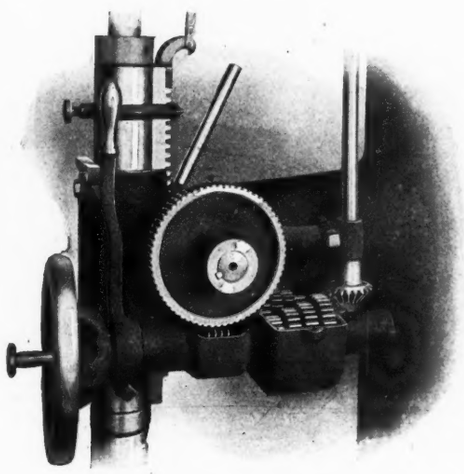
SIMPLE?

THE

GEARED FEED

OF THE

Sibley Hi-Speed Drill



is a model of operating convenience. The four changes are obtained by moving the knob in center of hand wheel. The gears and worm run in an oil bath.

SIBLEY MACHINE TOOL COMPANY

No. 8 TUTT STREET, SOUTH BEND, INDIANA, U. S. A.

Coes Name is Always on the "Coes" Genuine Wrench

If you are offered a "Coes" Wrench with a jobbers' brand on it—rest content, it is an imitation or a substitute for the genuine "Coes". It may cost less but it will be worth less. We do not make cheap wrenches—we have no job lots, jobbers' brands or "factory seconds", we make the best wrench that can be made and never deviate from our high standard.

The wrench for heavy service must be strong in *all* parts—not in some; it must be simple, well balanced, well hardened; put together to stay, and supported at all possible points where strain would injure it. It must stand the wear and tear of rough usage, meet unexpected conditions and cover a wide range of work. The fact that the yearly output from the "Coes" factories is more than 85,000 dozen wrenches is pretty strong evidence that the "Coes" wrench has all these qualities and "then some".

5 Styles and 50 Sizes

COES WRENCH COMPANY

Agents: JOHN H. GRAHAM & CO.
113 Chambers Street, New York.
14 Thavies Inn, Holburn Circus, London, E. C.
Copenhagen, O. Denmark.

WORCESTER MASS.

Agents: J. C. MCCARTY & CO.
21 Murray Street, New York.
438 Market Street, San Francisco, Cal.
1515 Lorimer Street, Denver, Col.

ARMSTRONG TOOL HOLDERS

will do more work and cause less trouble than any other tools you can put on your lathes and planers.

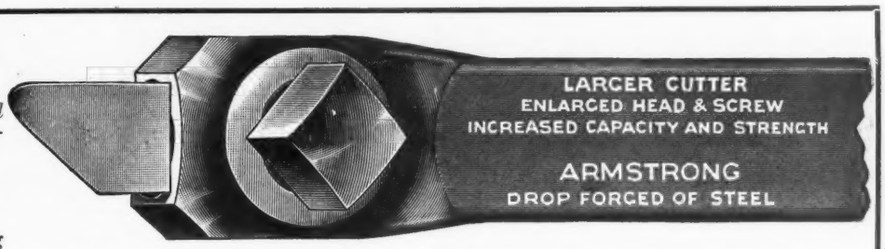
We make a complete line. A Tool Holder for every operation on the lathe or planer.

Cutter is Extra Large

and has *Reinforced Support* directly under strain of cut.

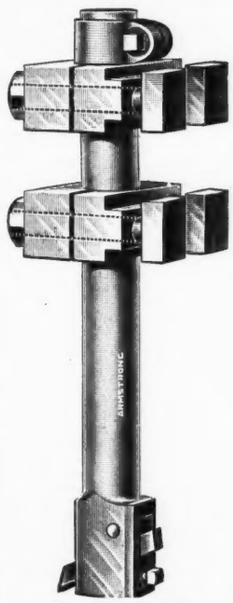
Our Patented Relieved Seat

prevents chattering and breaking of cutter.



Make One lb. of Tool Steel Equal Ten lbs. in Forged Tools.

This HOLLOW BAR SLOTTER TOOL



Pat. Dec. 1, 1903.

Is made in 5 sizes

6 to 24-in. Stroke

Bar 1½ to 2¾-in. Diameter

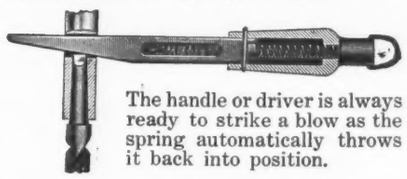
It relieves on return stroke and will cut clear down to table. It is very stiff in proportion to its weight and the split collar enables the machinist to adjust it easily.

Write for Special Circular.

It's as Handy as an Extra Hand.

THE AUTOMATIC DRILL DRIFT

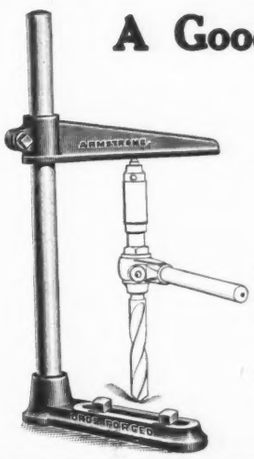
You'll wonder how you got along without it.



The handle or driver is always ready to strike a blow as the spring automatically throws it back into position.

Write for Special Circular.

A Good Old Man



Is The New Armstrong

Drilling Post

For Use With Ratchet Drills.

SPECIAL FEATURES

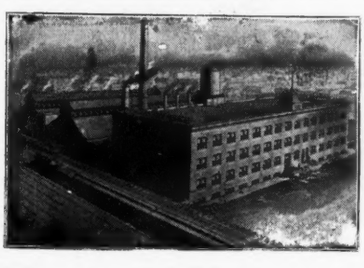
Drop Forged Arm and Foot. Removable Post. Hardened Binding Screw.

Packed one in a box and labeled.

3 Sizes: 8, 10 and 12 inches.

Write for Special Circular.

We make a complete line of Ratchets.



Do you want our new catalog? It's a Tool Holder Encyclopedia.

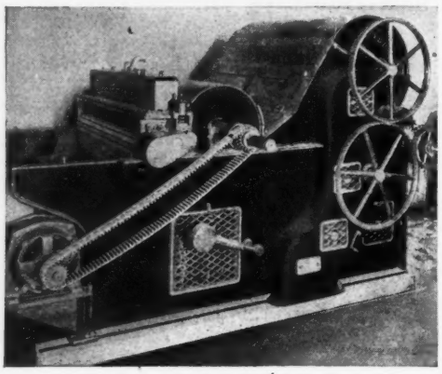
Armstrong Bros. Tool Co.

"THE TOOL HOLDER PEOPLE"

313 N. Francisco Ave., Chicago, U. S. A.

Imitations are Unsatisfactory. Infringements are Unlawful.

Morse Chain Silent Drive



Power transmission of the highest degree of efficiency and uniformity

is demanded in the textile industry. Both the quality and quantity of product depend upon a drive of uniform speed. This explains the rapidly increasing use of Morse Chains in this industry.

We illustrate a 5 horsepower Morse Chain Drive to picker; some details are: 1730—1565 R. P. M., 18-inch centers; Sprockets 19 and 21 teeth; Chain $\frac{5}{8}$-inch pitch, 2 inches wide; Speed 1720 feet per minute.

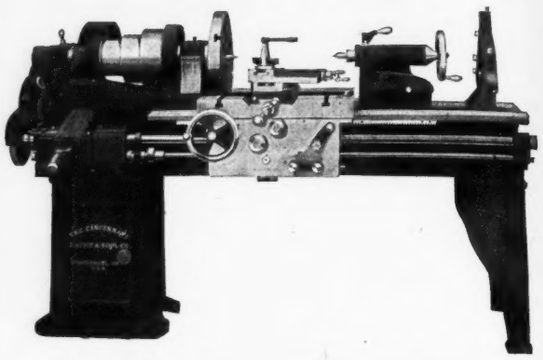
Send for Circular No. 9

Morse Chain Co.

ITHACA, NEW YORK

Licensees for Great Britain and Europe: The Westinghouse Brake Co., Ltd., York Road, Kings Cross, London, N.

Demand for Cincinnati Lathes

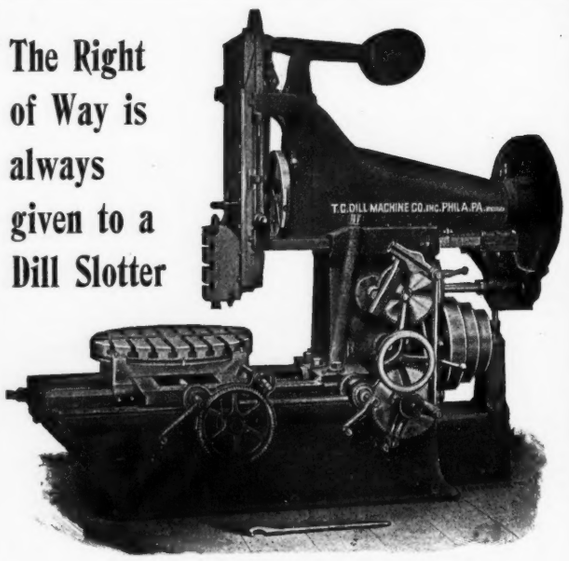


everywhere because of our experience intelligently applied. At its price is the best and most thoroughly made it is possible to buy. All have **double wall apron, chasing dial,** and **automatic stop.** Furnish **Quick Change** or another unlimited **Feed Box.** Compare in detail with others.

The Cincinnati Lathe & Tool Co.

Station B, Cincinnati, O., U. S. A.

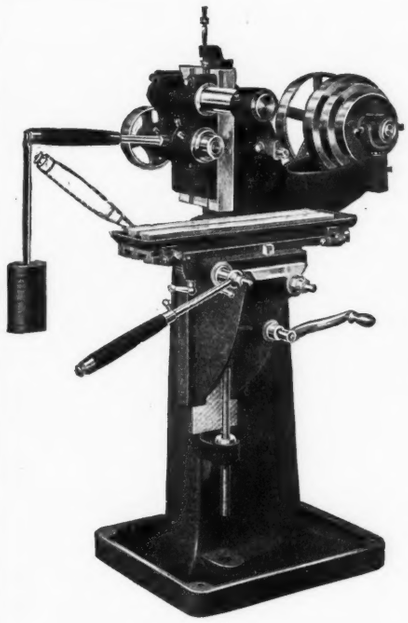
The Right of Way is always given to a Dill Slotter



In the machine shop—railway or manufacturing—the "Dill" is a cost reducer and first-class producer of accurate work. The traveling head makes a big slotter of a small one, and permits large or awkward pieces to be handled easily and quickly. Power traverse, safety device for feed and a wide range of speeds are also Dill advantages—all described in detail in the catalog.

THE DILL SLOTTER PEOPLE

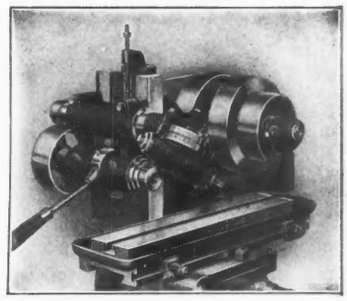
KENSINGTON, PHILADELPHIA, PA.

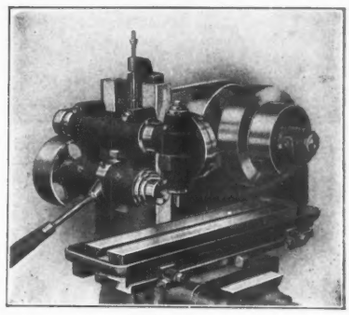


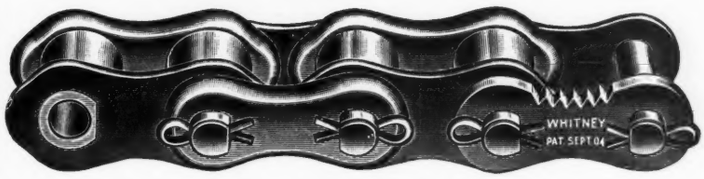
This New Vertical Universal High Speed Milling Attachment makes the

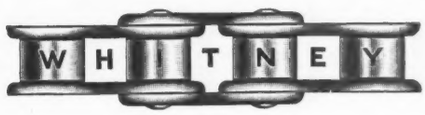
"Whitney" Hand Miller

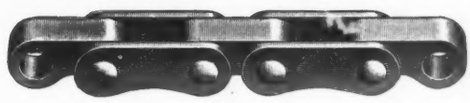
one of the most complete and desirable tools on the market for a wide range of work.







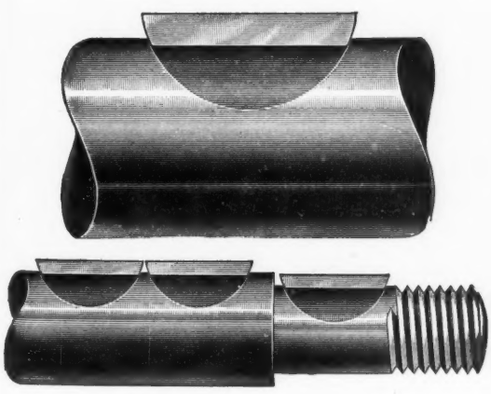




USE THE

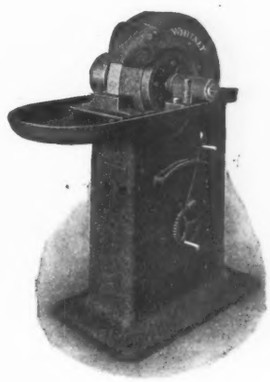
"Whitney" High Grade Driving Chains

For Machinery, Automobiles, Motorcycles, Bicycles, etc.



The "Whitney" 20-Inch Tool Grinder

is popular on account of Efficiency, Simplicity, Quality, Finish and Price.



If you are not taking advantage of the

Woodruff Patent System of Keying

it will pay you to investigate.
Better results and a great saving in cost.

The Whitney Mfg. Co.

HARTFORD, CONN.

Patented in U. S. A. and Foreign Countries

WHEN EQUIPPING YOUR PLANT SPECIFY THE "AMERICAN" STEEL SPLIT PULLEY

Then you need give no second thought to that part of your transmission equipment for you will have pulleys of the most accurate design and construction, perfectly balanced, light yet strong, thus requiring much less power to turn, easily put up or taken down from shaft—in fact, pulleys which will win your increased liking every additional day in use.

Sold by leading supply houses. New catalog now ready.

The AMERICAN PULLEY COMPANY

Chicago Branch, 124 So. Clinton Street — Main Office and Works, PHILADELPHIA, PA.

Ford Chain Block Co.

Sent on Trial Anywhere

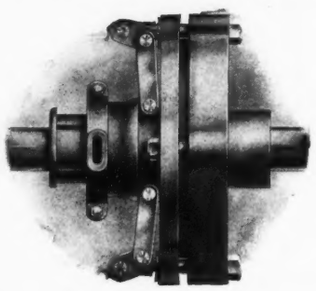
TRIBLOC CHAIN HOIST

PERFECT CHAIN GUIDE

Simple Mechanism
Interchangeable Steel Parts

135 No. Second Street
PHILADELPHIA, PA.

The Acme of Simplicity



In Clutch Construction

has been reached in the Latest Improved Worrall Friction Clutch. It is built on the principle of a solid flange coupling with the addition of simple levers to afford a means of connecting and disconnecting instantly. In addition to its simple mechanism, this clutch offers advantages which are not met with in any other make. It has demonstrated its superiority over all other clutches for all purposes, and is the choice of practical men the world over. The almost universal use of the Worrall Clutch under all conditions is its strongest claim for favorable consideration.

We build "A Special Clutch for every Special Purpose". Better let us design a special clutch to meet your requirements and give you the benefit of our long experience.

Send for catalog. It illustrates various improved methods of transmitting power by means of this clutch.

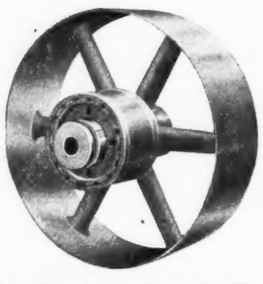
American Twist Drill Co.

Established 1865 — Dept. A, LACONIA, N. H.

3,000 GRIPS A DAY WITHOUT A SLIP

The perfect control of "AKRON" Friction Clutches in the line of heavy service brought us the following:

"These clutches must be operated 3,000 times every 24 hours in our work and naturally the service is very severe. Your clutch has stood up to this work in the best possible manner and we have not spent a cent on it for repairs."



The smooth, positive action of "AKRON" clutches is always assured because all pressure is in line with the shaft and, once engaged, all end thrust is eliminated.

If you need a powerful, satisfactory clutch, write for the Akron booklet.

The Williams Foundry & Machine Co., Akron, Ohio, U.S.A.

TOOLS THAT NEED NO NURSING

A tool that isn't dependable—that is erratic in its behavior—that must be "nursed" to make it do its work at all—isn't a good tool for your purpose.

The tool you want is always ready for business, and works hard and fast and profitably.

The difference between these two kinds of tools is in the amount of care and "know how" applied in their design and construction.

"CROWN" AND "IMPERIAL" PNEUMATIC HAMMERS AND DRILLS NEED NO NURSING. OPEN THE THROTTLE—AND THEY'RE READY FOR THE DAY'S WORK, AND A VERY GOOD DAY'S WORK, TOO.

We have built them as well as we possibly can, with thirty-nine years of experience to teach us. We know that no tools can be better built.

We offer you "Crown" and "Imperial" Tools with no wildly extravagant claims as to their performance, and with no "extras" thrown in.

We urge them upon you with the firm conviction that you will find them to be steady, reliable, profitable "tools for service."

Your request will bring you our Tool Bulletins.

AIR COMPRESSORS AIR HOISTS

INGERSOLL-RAND CO.

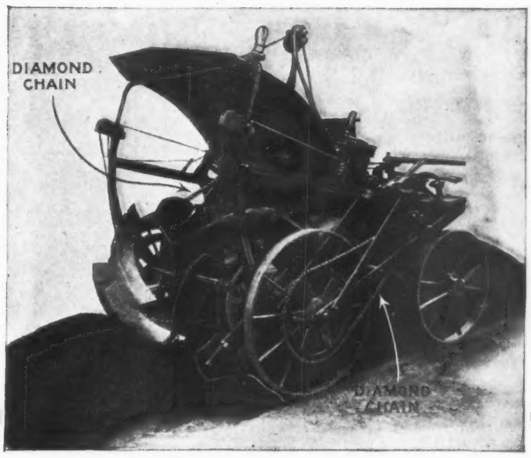
NEW YORK LONDON

DOMESTIC OFFICES:

Birmingham	Cleveland	El Paso	Philadelphia
Boston	Denver	Los Angeles	Pittsburg
Butte	Duluth	New York	St. Louis
Chicago	Salt Lake	San Francisco	Seattle

FOREIGN OFFICES:

Budapest	Johannesburg	London	Mexico	Paris
Dusseldorf	Kobe	Melbourne	Montreal	Yokohama



DIAMOND CHAINS ONLY WOULD DO THE WORK HERE

This machine mixes foundry sand, the knives making a cut every half inch from the top to the bottom of the pile. Of course some of the damp sand gets onto the power transmitting mechanism around the knives, and this would knock out belting or gears in no time.

Diamond Chains have long been used to drive both wheels and cutting knives, and do their work well in spite of the dampness and the dirt. In fact, the whole machine is dependent for its success upon durability and satisfactory service from the chains.

That Diamond Chains are honestly good and are able to withstand such rough treatment is emphasized by Mr. George Lorimer, President of the Auto Sand Mixer Co., Piqua, Ohio, makers of the above machine, who comments as follows:

"The chains have given satisfaction and wear remarkably well considering that they are working in sand at all times and one of them at quite high speed. The chains wear longer than the sprockets under very hard conditions."

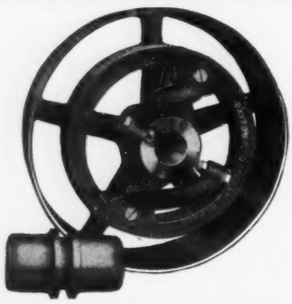
Let our engineers advise you about your troublesome drives. Ask for book "Chain Transmission of Power."

TRADE ◇ MARK

DIAMOND CHAIN AND MANUFACTURING CO.

240 W. Georgia St., Indianapolis, Ind.

Capacity 8,000,000 Feet Per Year.



THE EDGEMONT FRICTION CLUTCH PULLEYS

are made to stand the hard usage and abuse the countershafts are subjected to, since the advent of high speed steel and heavy duty machine tools. This is the reason many of the leading Machine Tool Manufacturers have adopted the Edgemont Clutch. Our catalogue C tells who and is descriptive of the different style Clutches we make. Our Extended Sleeve style is made for line-shaft drive up to 50-H.P.

Write today for catalog.

The Edgemont Machine Co.
995 Washington St., Dayton, Ohio

"BROWNHOIST"

LOCOMOTIVE CRANES

Are the Most Efficient on the Market

The crane shown in the engraving is a standard 15-ton, 8 wheel, M. C. B. truck, two drum crane, equipped with a "Brownhoist" 54 cubic foot Grab Bucket.

We can interest you—write us.

THE BROWN HOISTING MACHINERY CO.
Main Office and Works, Cleveland, O.
Branch Offices, New York and Pittsburg.

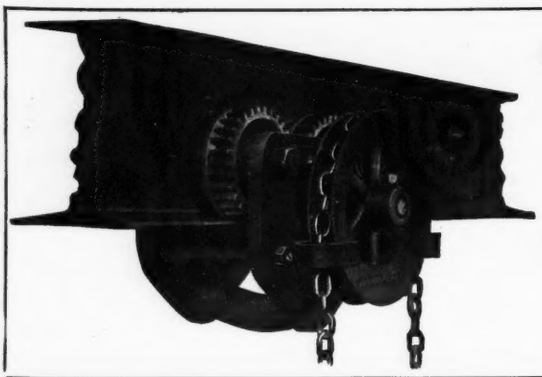
DIE CASTINGS

Stamped Metal Parts

Finished Brass Castings

To your Drawings

Parker White Metal and Machine Co.
Erie, Pennsylvania, U.S.A.



Trolleys

MARIS BROS.
PHILADELPHIA PA.

ONE TO TEN TONS

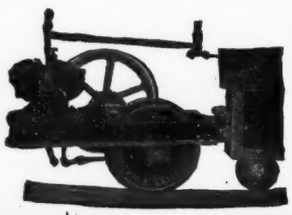
PNEUMATIC GEARED HOISTS

and other labor saving compressed air appliances.

Durability and efficiency guaranteed.

DETROIT HOIST AND MACHINE CO.
Successors to PILLING AIR ENGINE CO.
DETROIT, MICH.

Locomotive Turntable
Pneumatic and Electric Mule



REAMERS

The KELLY Adjustable

MADE IN

ONE STYLE ONLY

Finish, Ream or Rough-bore ANYTHING from a

ONE-INCH to a SIXTY-INCH CYLINDER

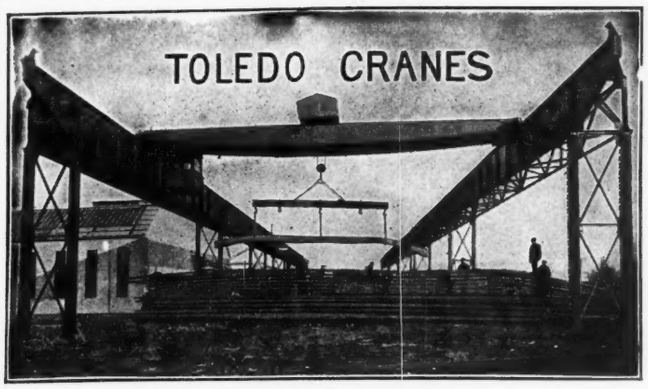
Type B for the Turret. Type C for Cylinders.

THE KELLY REAMER CO., Cleveland, U. S. A.
Successors to THE KELLY TOOL CO.

CRANES AND HOISTS

All Types and Capacities

ALFRED H. BOX & CO., Philadelphia, Pa.



Hand and Electric Cranes

For any service:

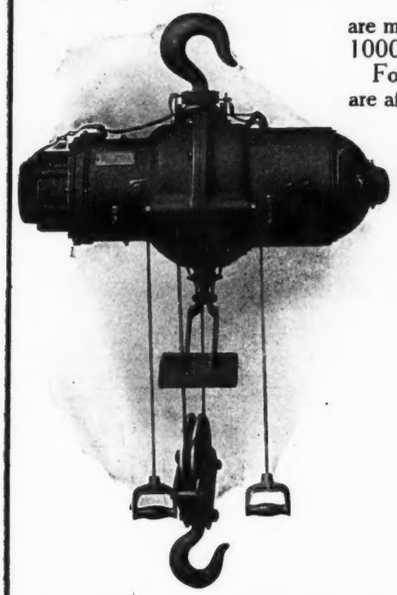
Experienced Engineers.
Old and Tried Crane Designs.
Steel Structures, etc.

Mr. Chas. H. Tucker has had 20 years' experience on Crane Design and has entire charge of our Crane Department.

Let us show you.

The Toledo-Massillon Bridge Co.
TOLEDO, OHIO
SALES AGENTS: C. E. Stamp & Co., Cleveland, Ohio.
Cincinnati Iron and Steel Co., Cincinnati, Ohio.

Shepard Electric Hoists



are made in capacities of 1000 to 40,000 pounds. Four hundred types are afforded by different combinations of standard machines so we are able to meet most any requirement without going into special apparatus.

Gearing, controller and all other parts are fully enclosed in dust tight cases.

All gears are run in oil baths.

Main Office and Works

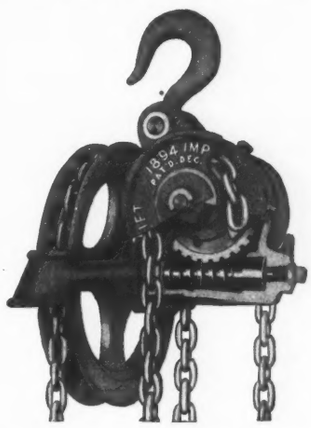
Montour Falls, New York

Write for Electric Hoist Hand Book.

Shepard Electric Crane and Hoist Company

New York Philadelphia Pittsburg Chicago
Toronto Atlanta San Francisco

Interested in Screw Hoists?



IF YOU ARE, the Harrington Improved Screw Hoist will prove to be the very one you are looking for.

IF YOU ARE NOT, a slight study of its valuable features—its absolute safety, strength, convenience and reliability—will make you an enthusiast.

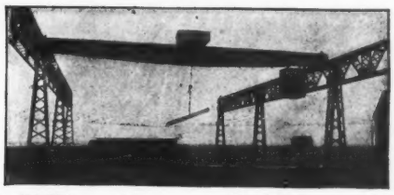
Catalog "H" describing the full line of Hoists and Travelers is yours for the asking.

EDWIN HARRINGTON, SON & CO., Inc.
PHILADELPHIA, PA.

ALL KINDS
ALL CAPACITIES
Get Catalogs

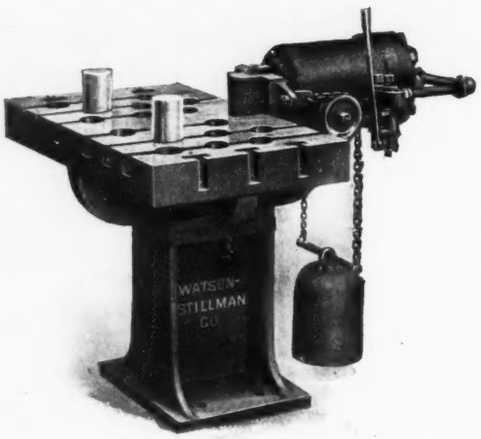
NORTHERN CRANES

Electric
Direct
or
Alternating
Current



ELECTRIC HOISTS
Get Prices

Northern Engineering Works, 26 Chene St., Detroit, Mich.
New York: 120 Liberty Street
Chicago: 539 Monadnock Block



Hydraulic Bending Machines

Hydraulic power is by far the most economical and effective for bending large pipe, structural sections, automobile parts, metal bars and the like.

Watson-Stillman hydraulic bending machines are made in many types, one of which is shown above. This small bender is capable of exerting a power of 25 tons under an operating pressure of 2000 lbs. per sq. in. The size, shape, and arrangement of the pins, holes and slots in the table can be arranged to meet special conditions.

For heavier work we make a larger bender with opposed cylinders, having a common ram which actuates a bending pin or steel-faced bending blocks. In this type the cylinders operate simultaneously and the center of the ram can be located at any desirable distance below the table top.

Tell us your requirements and if our standard machines will not do your work, we are ready to build others that will.

Our line includes hydraulic pumps, presses, accumulators, intensifiers, punches, shears and jacks. State which interest you, so we can send catalogs.

W-S HYDRAULIC
TRADE-MARK

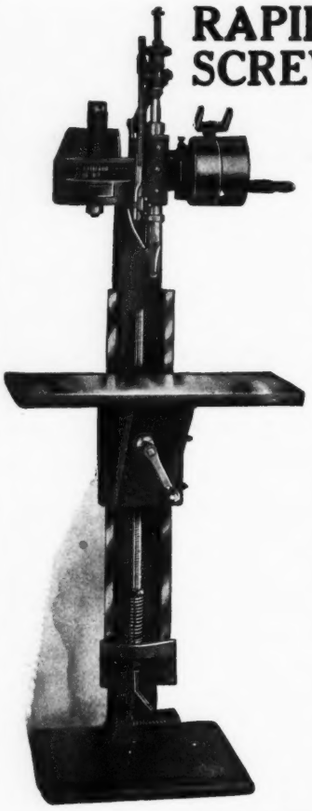
The Watson-Stillman Co.

ENGINEERS, BUILDERS OF HYDRAULIC TOOLS AND TURBINE PUMPS

192 Fulton Street, NEW YORK

44

RAPID-FIRE SCREW SETTING



Reynolds Automatic Screw Driver

limits the output only to the operator's ability, driving screws faster than any operator can feed the work.

This means economy in the setting-up room that beats the best ratchet driver with speed and quality of output.

It is not necessary to make any changes for different lengths; screws are arranged from bulk and can be driven without previously drilling the work.

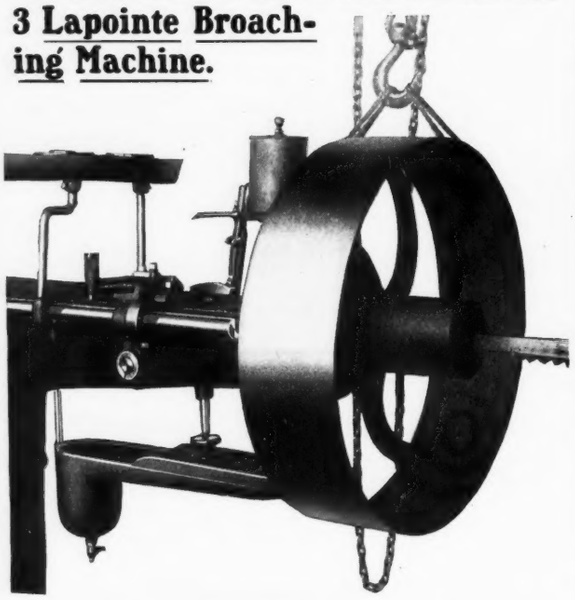
A boy can work it as well as a man, and screws will be set uniformly and as tight as wanted.

Catalogue?

REYNOLDS MACHINERY COMPANY

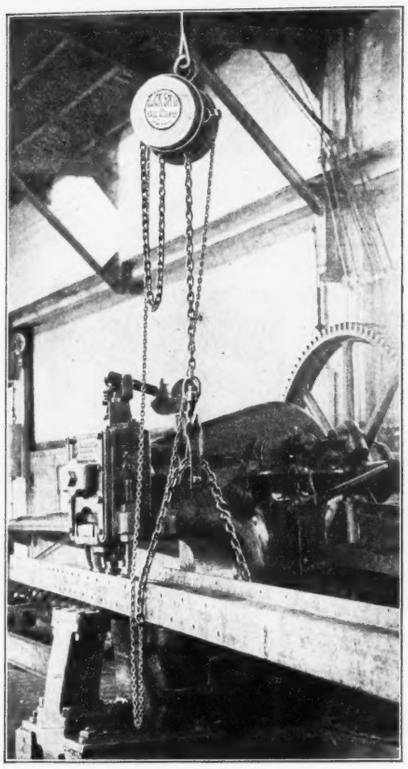
MOLINE, ILL., U. S. A.

A 5/8" x 10" Long Keyway Broached in a Pulley in 1 minute's time on the No. 3 Lapointe Broaching Machine.



Square or other shaped holes can also be broached just as easily. So what is the use of having two or three special Keyseating Machines when one Lapointe Broaching Machine will do more work and more accurately than any Keyseating Machine. If you do not believe it don't ask Sweeney, but write us.

Lapointe Machine Tool Co., Hudson, Mass.



A Triplex Block serving a punch.

One Man Does It All!

PUNCHING holes in a girder is easy—the real work is in getting the girder to the punch—adjusting it for the operations—and carrying it away. One man with a Triplex Block suspended from a trolley, does the whole thing. He picks up a girder by pulling on the hand chain—carries it to the punch by pushing it along the trolley—which also enables him to adjust it quickly and with absolute accuracy.

He can then move the girder to any other point in the works or deliver it on board the car for shipment.

The whole installation is inexpensive and pays for itself over and over again, because the initial saving of a Triplex Block keeps on for a life-time.

You may have one to try by just asking us or your nearest dealer.

Chain Blocks { **4 styles:** Differential, Duplex, Triplex, Electric. **42 sizes:** One-eighth of a ton to forty tons. **300 Active Stocks** ready for instant call all over the U. S.

Send for the Book of Hoists today — Yours for a postcard.

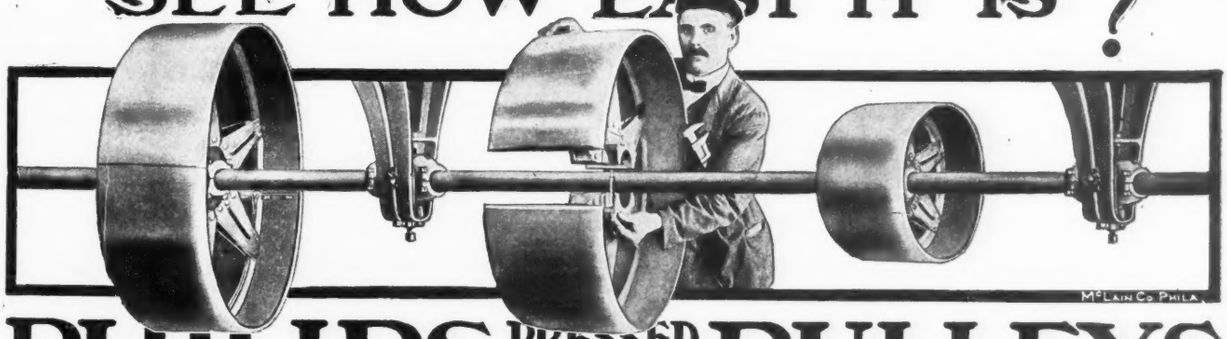
The Yale & Towne Mfg. Company

Only Makers of Genuine *Yale Products.*

9 Murray Street - - New York

Local Offices: Chicago Philadelphia Boston San Francisco

SEE HOW EASY IT IS ?



PHILIPS PRESSED STEEL PULLEYS

Can be placed in position in 5 or 10 minutes without disturbing the shaft.

Compare this to time and expense necessary to mount a solid pulley—in stripping everything else from the shaft and replacing again.

Further, consider that there are no set screws or keyways necessary with the Philips—

All you have to do is, have the two halves of the Philips fastened loosely together at one end so as to make a hinge of one of the rim lugs—separate the halves far enough one from the other to pass over the shaft.

Then, simply get the pulley in line; tighten up the hub bolts—draw rim bolts and you have a satisfactory running pulley.

As we use a cast iron hub, the compression of these four hub bolts gives a grip which makes it impossible for a Philips Pressed Steel Pulley to slip on the shaft.

As we can't tell you more than this one point in this space, we've attached a coupon right to this ad.

Please send us your name and address on it so we can *show you* how the Philips can solve your pulley problem; and send it now before you forget.

Philips Pressed Steel Pulley Works
341 Glenwood Ave., PHILADELPHIA, PA.

COUPON

Philips Pressed Steel Pulley Works,
Philadelphia, Pa.

Gentlemen: Replying to your ad. in MCHY., August, send me booklet and information about the Philips Pressed Steel Pulley.

Name .....
Firm .....
Firm Address .....
Business .....

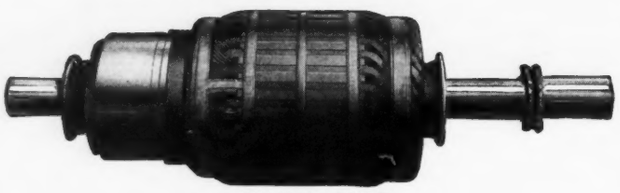
REMEMBER

that we are the largest concern in the world, with the most complete and up-to-date equipment, for doing all kinds of

ELECTRIC WELDING

We have machines especially adapted to all classes and conditions of work.

Our operators are no theoretical men, but are practical mechanics, developed in our own factory, under the direction of one of the most able-bodied men connected with the electric welding business.



ARMATURE SHAFT
Weight 1500 lbs.—shaft 4¼ in diameter

We want to assure you that there is more to electric welding than the simple application of the current, and to be a successful operator of an electric welding machine is a profession that can only be acquired through years of actual experience.

With our large and excellent equipment and thoroughly trained operators we are in a position to give you the best possible service and at a less cost than can be secured through any other source.

AUTOMOBILE DRIVE SHAFT CASING

Don't get the impression that electric welding is practical only for small work, where strength is of little or no importance, but send for our art booklet in which is illustrated a number of large objects electrically welded by our process, and you will note that they are parts in which strength is the one and most important feature, and on which a great amount of dependence is placed.

The Standard Welding Company

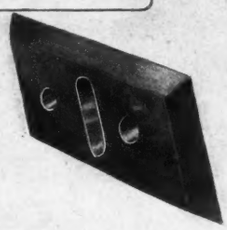
Western Representative,
L. F. McCLERNAN,
Monadnock Block,
CHICAGO.

CLEVELAND

Eastern Representative,
L. D. ROCKWELL,
United States Express Bldg.,
NEW YORK.

This Steel Hardens at Low Heat in Water or Oil

FOR DIES
Absolutely Non-Shrinkable



FOR END MILLS
Holds a Cutting Edge

FOR SHEAR BLADES
Tough and Strong

FOR PUNCHES
Density to Stand a Blow or Pressure

FOR MILLING CUTTERS
Increases Cutting Power

THE UNIVERSAL STEEL INTRA FOR ALL PURPOSES

FOR REAMERS
No Loss in Shape or Size

FOR LATHE TOOLS
"High Finishing Steel"

FOR TAPS
Long Wearing

An Alloyed High per cent Tungston Steel especially adapted for cutting steel on a water finish. All the advantages of the highest quality steel at a moderate price.

HERMANN BOKER & CO.

101-103 DUANE ST., NEW YORK CITY

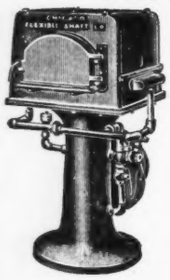
CHICAGO WAREHOUSE, 217-223 N. Desplaines St.
MONTREAL, CANADA, WAREHOUSE, 332 St James St.

PACIFIC COAST AGENTS
Pacific Tool & Supply Co. San Francisco, Cal.

STEWART FURNACES

Adapted for use with any kind of gas, or with crude oil.

Proven efficiency and economy



Muffle and Oven Furnace

For heating dies, milling cutters, tools of all kinds, cutlery, springs, reamers, etc., this furnace is unquestionably the most practical made.

No. 1—Complete, with blower..... $100.00
" " without blower 75.00
No. 2—(as illustration) with blower.. 160.00
" " without blower 120.00

Soldering Iron Heater

For Gas Only

The most efficient of its kind on the market. Compactly and solidly built. Flame is projected upward from the bottom and surrounds the irons, heating them uniformly. Flame may be regulated by valves at right.

Price..... $8.00

Barium Chloride Furnace

Designed especially for hardening high speed steels. Special analysis fire-clay linings; no useless apparatus. Perfect combustion and absolute control of heat. Allows the life of high speed steel tools to be doubled.

Prices..... $40.00 to $150.00

Metal Melting Furnace

This is the most satisfactory furnace made for melting brass and other metals. The specifications are similar to those of the Barium Chloride furnace for high speed steels, but is fitted with an automatic device for swinging the cover

Prices..... $43.00 to $155.00

Cyanide Hardening Furnace

Similar to the single crucible furnace, but is more practical for use on cyanide hardening. Allows cyanide to be raised to desired temperature quickly, and retained indefinitely. Very compact and requires little attention.

Price, with blower..... $75.00
" without blower..... 50.00

SEND FOR CATALOG TODAY

Send for our large catalog. Shows dozens of styles; gives descriptions and prices of each. Free on request.

Soft Metal Melting Furnace, No. 3

For Gas Only

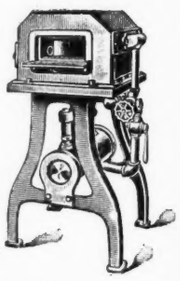
Cover is of cast iron and swings easily on a metal pin hinge. This allows all the heat to be retained and expedites the bringing of metal to the melting point. In fact, with this furnace melting point can be reached in 15 minutes after the furnace has been heated.

Price, without blower..... $55.00
" with blower..... 80.00

Cyanide Hardening Furnace, No. 10

This furnace allows cyanide to be brought to hardening heat in about 40 minutes (starting with the furnace cold) and can be retained at this heat indefinitely. Burners are so arranged that flame strikes the pot at a tangent, giving a rotary motion to the heat and allowing heat to be evenly distributed.

Price, complete, with blower $100.00
" " without blower 75.00



Stewart Forges

(No. 3 Illustrated)

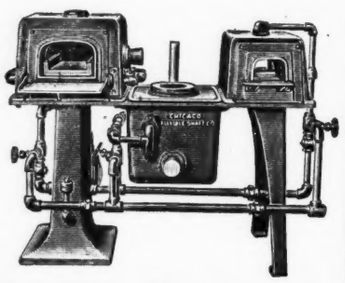
These are ideal for making small forgings for tool dressings, etc. required heat is quickly produced and can be retained for almost any length of time. Takes only one minute to reach a forging temperature.

Price, without blower.....$40.00
" with blower..... 65.00

Special Combination Furnace

Here's an oven furnace—crucible and forge furnace—all combined on one base for reasons of economy and convenience.

Price,
With blower..$125.00
Without " 100.00



Chicago Flexible Shaft Co.

149 La Salle Avenue, Chicago

Foreign Agents: FENWICK FRERES.....Rue de Rockroy, Paris, France
CHICAGO FLEXIBLE SHAFT CO.....London, England

ROCKWELL FURNACE FACTS

The automobile parts shown in the accompanying cut were exhibited by the American Vanadium Co. at the Master Car Builders' and Master Mechanics' Convention at Atlantic City.

Vanadium Steel Automobile Parts
ACCURATELY HEAT TREATED
in Furnaces Built by
Rockwell Furnace Company
26 Cortlandt St. New York.
Elastic Limit 101,000 lbs.
Tensile Strength 125,000 "
Elongation in 2 inches 20%
Reduction of Area 55%

The pieces shown were treated by the American Locomotive Company at their Providence Works in furnaces built by us.

These pieces were bent cold, the test being an exceptionally severe one.

The excellent results shown are only possible where proper heat treatment can be obtained, and where reliance must be placed in any steel our Accurate Temperature Furnaces are a necessity.

Guesswork is inexcusable.

We guarantee that an accurate and controllable temperature can be attained and maintained in our oil or gas fired furnaces, and by their use and the aid of a pyrometer an absolute check can be had upon the work produced.

Prices and specifications covering your requirements for the asking.

WRITE FOR BULLETIN "G-11."

ROCKWELL FURNACE CO.
26 Cortlandt Street NEW YORK

HEATING MACHINE

No. 29

For Continuous Hardening or Annealing.

Originally designed for hardening or Annealing quantities of ball Bearings, detachable **Saw Teeth, Spring Washers, Nuts, Bolts, Screws, Annealing Brass Shells,** and other work not exceeding 2½ inches in any dimension.

Capacity of the Retort is from 75 to 100 lbs. per hour, depending upon the weight and dimensions of the pieces to be treated.

Made in various sizes.

What We Make

Pressure Blowers **Heating Machines**
Gas Blast Furnaces **Blow Pipes and Burners**

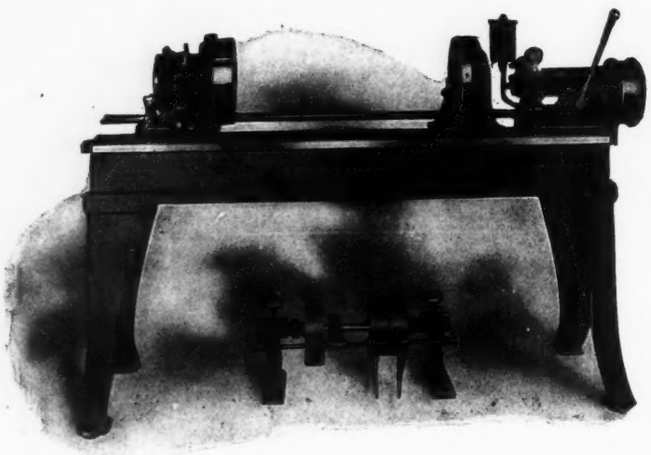
GAS is not "The Cheapest Fuel," but no other kind of Fuel can be used to such advantage in manufacturing processes which require **Precision** in the use of heat. This statement is confirmed by an experience of over twenty years acquired in **the utilization of Gas in Mechanical Heating Processes,** which is **our Specialty.**

Catalog sent on application.

American Gas Furnace Company
24 John Street, NEW YORK

THE WHITON
Revolving Centering Machine

For Accurately Centering Finished Shafts



The cut shows new REVOLVING CENTERING MACHINE—a large size of the well known machine of this type. It is heavier throughout and has capacity to center shafts up to 5 inches in diameter.

Constructed same as the smaller machine and embodies all the special features.

Circulars and prices sent upon application

The D. E. Whiton Machine Company
New London, Connecticut

IMPROVED NEW HAVEN LATHES

21" Swing, Double Back Geared

Those who recognize New Haven Efficiency are not afraid to make full use of it.

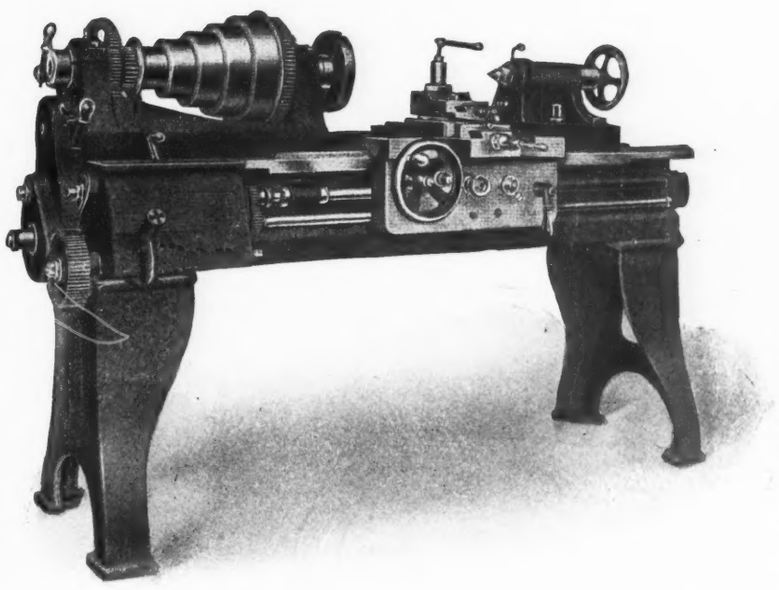
The Standard 21″ Lathe is built for heavy work and hard continuous service in shops where each machine has to do more than usual. Such features as extra powerful drive, double wall apron and quick change gear device are incorporated in New Haven Lathes, giving them a strength, capacity and convenience which more than live up to the expectations of the operator. For sixty years New Haven Lathes have been sold for exceptional service. Every one of the line from 18″ to 65″ swing is powerful enough to take heavy cuts with high speed steel, rigid enough to work smoothly without vibration and accurate to the last degree practicable. *Send for the new catalog.*

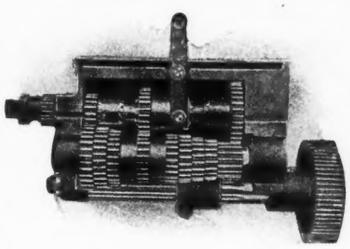
New Haven Manufacturing Co., New Haven, Conn.

The Flather Quick Change Gear Lathe

Latest and Best.
Strong and Simple.
Least number of Gears.
Greatest number of Threads and Feeds.

Send for descriptive circular.





Flather & Company, Incorporated, Nashua, N. H.

Our All Geared Automatic Tapping Machine

is very strong, powerful, rapid and accurate. Reverses instantly and automatically at any exact depth required.

Specially adapted for tapping blind holes and bottom or depth work, but will handle regular tapping with equal advantage.

The friction clutch gears are on the driving end of the machine—not on the spindle.

There are no cone belts, machine has four direct **geared speeds** and four **back geared speeds**. Furnished with our wide range of **positive power feeds** when desired, thus adapting it for drilling as well as tapping.

It is very conveniently arranged for ease and speed of control, and has but one pulley for driving and reversing.

Built in 20-inch and 24-inch sizes.
Bulletin gives details, send for it.

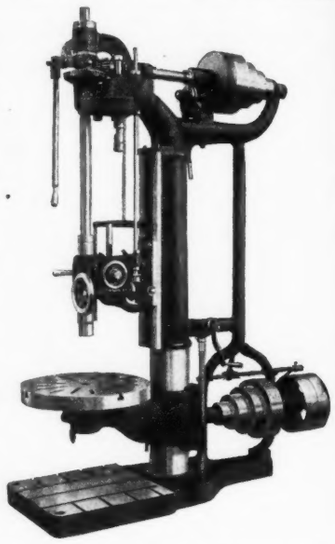
BARNES DRILL CO., Inc. 1907
814-830 Chestnut St., ROCKFORD, ILL., U. S. A.

Agents for Germany and Austria: E. Sonnenthal, Berlin, C.2, Cologne a/Rh, Frankfort a/Main, and Vienna. Agents for Great Britain: C. W. Burton, Griffiths & Co., London, E. C. Agents for Belgium: G. & F. Limbourg Freres. Agents for Ontario: Kellogg & Co., 196 King St., West, Toronto.

New Upright Drill No. 32

With Tapping Attachment and Geared Feed

The Mechanics line of high grade drills is noted for simple but powerful construction. No operating convenience has been overlooked, strength and rigidity are everywhere apparent, but the entire lack of complicated mechanism brings the manufacturing cost to a very moderate figure.

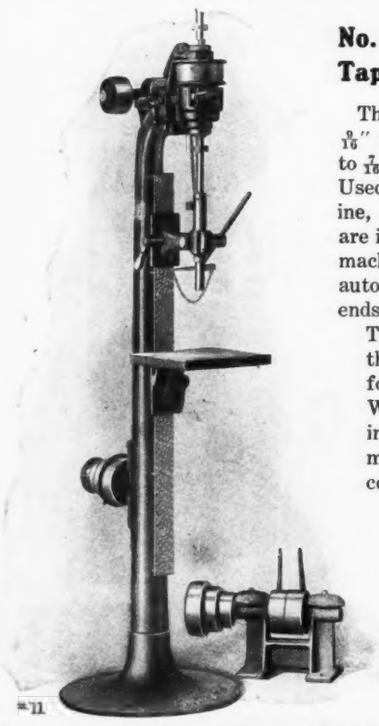


Write us for particulars, our line includes Standard Drills 32", 26", 24", 20", 14", 12"-B, sizes and No. 1 and 2 Friction Drills. All feeds "Positive." "Positive Feed".

Mechanics Machine Company
19th Avenue, Rockford, Ill., U. S. A.

AGENTS: Garvin Machine Co., New York. C. W. Burton, Griffiths & Co., London. Ateliers Demoor, Brussels.

Something Entirely New and Worth Your Attention



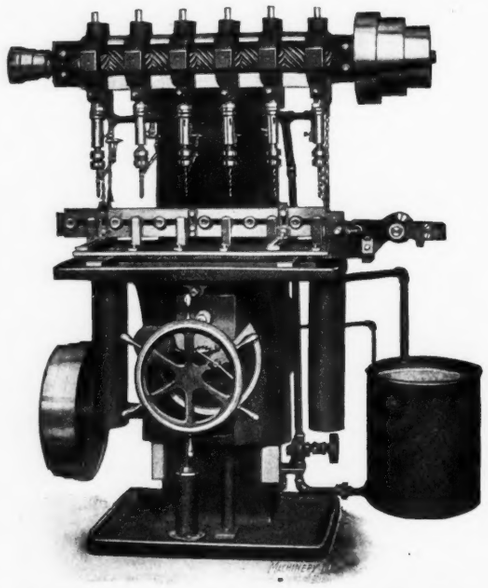
No. 11 Drilling and Tapping Machine.

This machine drills $\frac{9}{16}$" holes and taps up to $\frac{7}{16}$" holes in cast iron. Used as a drilling machine, all tapping parts are idle. As a tapping machine it reverses automatically at both ends of the stroke. This is a convenience that you cannot afford to be without. We have two styles in single spindle machines, and any combination in multiple spindle drills.

Write for circulars.

H. G. BARR, WORCESTER, MASS.
21 HERMON STREET

Continuous Drilling



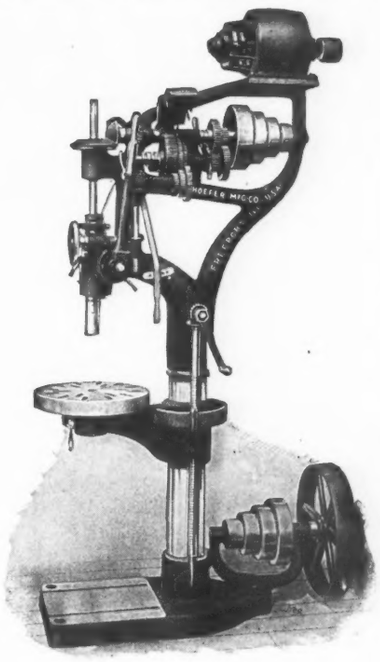
The sliding jig of **Moline Multiple Spindle Pin Drills** allows one set of work to be removed while the other is drilling, so operation is practically continuous.
Adjustment for holding different length and diameter cotter pins and similar work. Ball thrust bearings—vertical adjustment for various drills.

Send for complete details of Multiple Spindle and Gang Drills for every purpose.

MOLINE TOOL COMPANY, Moline, Ill., U.S.A.

AGENTS: Marshall & Huschart Machinery Co., Chicago, Milwaukee, St. Louis and Indianapolis.

A Line on HŒFER Drills is a Straight Line.



They are "straight" goods from the foundation up. We do our full duty when we build the machines—spare no time, labor or expense to secure and maintain the most accurate alignment in every part. Grind all sleeves, worms and shafts to accurate standard size and to secure true running fit. Make the machines a little heavier and more rigid than usual to handle the heavier work, use sufficient metal, properly distributed, to provide for working strain. Incorporate all the time-saving devices that practice has proved worthy. We make the HŒFER Drills as near right as a mechanical proposition can be made and shall be glad to send full particulars on request.

HŒFER MFG. CO.

120 Jackson St., Freeport, Ill.

DOMESTIC AGENCIES—Motch & Merryweather Machinery Co., Cleveland, Cincinnati, Ohio, Detroit, Mich.; Vandyck Churchill Co., New York City, Philadelphia and Pittsburg, Pa.; C. H. Wood Co., Syracuse, N. Y.; O. L. Packard Machinery Co., Milwaukee, Wis.; H. A. Stocker Machinery Co., Chicago, Ill.; H. J. Brunner Machinery & Mfg. Supply Co., Kansas City, Mo.; Pacific Tool & Supply Co., San Francisco, Cal.; Pacific Coast Mfg. Co., Los Angeles, Cal.; Colcord Machinery Co., St. Louis, Mo.; Cotton States Belting & Supply Co., Atlanta, Ga.; J. L. Osgood, Buffalo, N. Y.; W. P. Davis Machine Co., Rochester, N. Y.; Morrison Machinery & Supply Co., Richmond, Va.; Thomas & Lowe Machinery Co., Providence, R. I.; Scott Supply & Machinery Co., Denver, Colo.; Zimmerman-Wells-Brown Co., Portland, Ore.; Aumen Machinery Co., Baltimore, Md.; Hannon-Finton Co., Springfield, Mass.

36-in. x 36-in.—12-ft. Planer, with Motor Drive.

We have been Making CLEVELAND OPEN SIDE PLANERS For the past Seven Years

Bed, column and cross rail of Box Section Design.

All gears removable from side except bull gear, which lifts out from top.

Rack under table made of semi-steel.

All machines have countershaft attached to top of column.

Planers furnished parallel or right angle drive.

Any size from 30″ to 60″, any length.

Simplicity, without sacrificing any movement or convenience, is our aim.

Workmanship and facilities unexcelled.

Manufactured by

THE CLEVELAND PLANER WORKS

JAMES G. DORNBIRER
GEO. W. FORD

3150-3152 Superior Avenue
CLEVELAND, O., U. S. A.

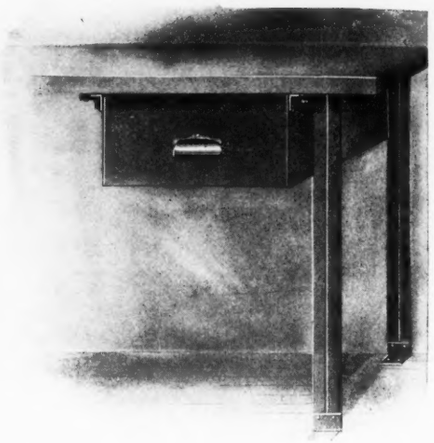
The New Tool Case

FOR MACHINISTS AND TOOL MAKERS

This is the one you've been looking for. It is entirely new in design and superior in workmanship. The case is well proportioned, has a strong handle on top and is easy to carry; there are seven drawers of various sizes, which hold every tool in proper condition and handy. The drawers have solid mahogany fronts, richly finished and green felt lined. The stationary tray above drawers takes care of all the heavy tools. This case is the lightest and strongest ever made; all lock-cornered and glued and covered with "Genuine Cowhide Leather" which gives it a beautiful appearance. *Write us for circular, full details cheerfully given.*

WEDELL & BOERS

157 Jefferson Ave., DETROIT, MICH.



STEEL BENCH DRAWERS

Size, 24 in. wide by 24 in. long by 6 in. deep. Finish, baked enamel. Arranged to slide on runners, and can be equipped with hasp for padlock. Easily attached to any bench.

Bench Legs—Steel bench legs for supporting wood bench tops made to order.

Steel Shelving, Racks, Bins and Lockers for shop or factory use.

Address for Catalog and Prices.

THE VAN DORN IRON WORKS CO.

METALLIC FURNITURE DEPARTMENT

CLEVELAND, OHIO

INTRODUCTORY OPPORTUNITY

PILLIOD TOOL CASES

save time and money for every up-to-date mechanic.

We want to introduce the line in your neighborhood and will send by express the best mechanics' tool case ever offered for $6.00. Golden quarter sawed oak; 5 drawers, all felt lined bottoms; cylinder snap lock, two keys; polished brass fittings; comfortable handle.

HANDSOME—STRONG—CONVENIENT

You'll be well satisfied and your associates will ask about Pilliod Cases.

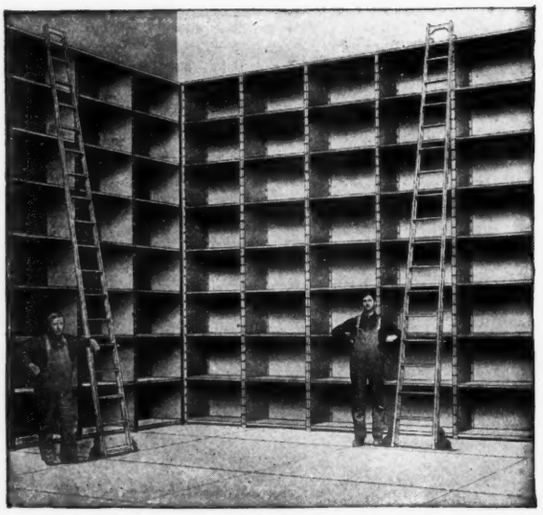
Send at once for catalogue. It illustrates other styles from $6.00—$12.00. Every case sold under our absolute guarantee.

The Pilliod Lumber Co., Swanton, Ohio.

STEEL EQUIPMENT

RACKS AND BINS, TRUCKS AND BOXES

STEEL LOCKERS



The best and most economical Racks.

WHY?

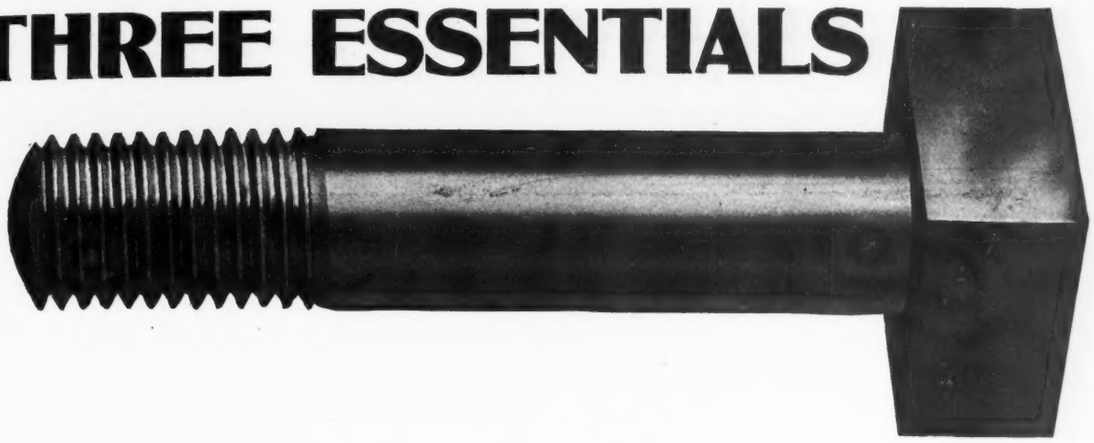
Strongest and simplest adjustment, greatest carrying capacity; suitable for the largest variety of requirements.

Save space and labor.

TERRELL'S EQUIPMENT COMPANY

NORTH GRAND RAPIDS, MICH.

THREE ESSENTIALS



QUALITY

Too little attention is given the big factor of QUALITY in buying. There are generally as many grades of quality as bidders and the tendency to regard prices only is altogether wrong.

You will find in our products—first of all—the best grade of material for the purpose—a distinctly different method of manufacture is used and the products are actually stronger and of better finish than others on the market.

PRICE

Our large finished steel bolts and screws, drill spindles, vise screw blanks, valve stems, rods and other machine, engine and automobile parts cost less the majority of times than inferior work made by other processes than the electric welding process.

In rare cases the price may be a trifle higher, but the difference in the quality, when considered, far over-balances the difference in prices.

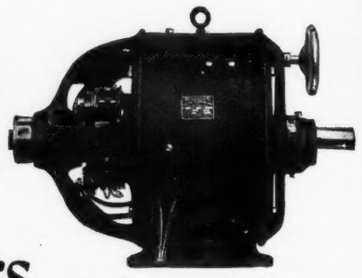
SERVICE

With your co-operation in anticipating your orders as far ahead as practicable, we'll give you the goods when you want them, as we are adding very heavily to our equipment.

You can ask about any other things of importance to you which we may have overlooked when you send in your next order or inquiry.

The Electric Welding Products Co., Cleveland, Ohio

When you install motor drive in your plant—get all the advantages



Why be satisfied with the ordinary type of motor which *almost* gives the desired results when you can get a *real* adjustable speed motor that *does* give the best possible results—the kind you want.

Reliance Adjustable Speed Motors

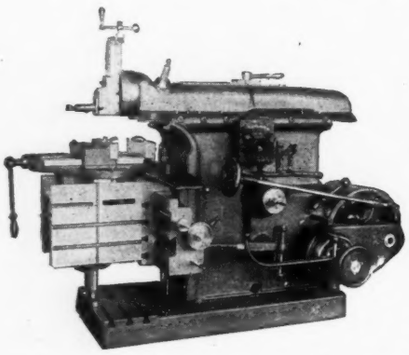
will give you all the usual advantages obtained with ordinary motors, such as greater cleanliness, better light, clear overhead space, flexible arrangement of machines, absence of belt and line shaft accidents, ample power at the cutting tool, and the greatest possible power economy.

What is of added importance on your machine tools is the accurate speed adjustment throughout wide and unbroken ranges in speed. The changes are smooth and gradual—no steps or jumps. You get the right speed for every operation on all kinds of work.

This is all accomplished easily and quickly by a simple mechanical method inside the motor—*no electrical controller is needed.*

The Ideal Drive for Your Machine Tools

Look at the illustration of the motor driven crank shaper. Note the compactness, and the simple and convenient method of speed control. An operator with a spark of energy will get the most out of such a machine.



Every machine in your plant regardless of its make or type is capable of producing certain maximum results. You can get these results all the time if you will provide your machines with the means of meeting the changing conditions which are constantly arising, especially in machine tool work. The power, overload capacity, and really accurate speed adjustment over wide ranges necessary to meet these conditions can be found only in the Reliance Adjustable Speed Motor.

If you have never had a chance to investigate the many merits and advantages of this wonderful motor at first hand, let us tell you of some of your neighbors who are using them. Our motor is its own best advertisement and the more familiar its users become with its efficiency and simplicity of speed control, the surer we are of a hearty recommendation.

If you are inclined to be skeptical when someone attempts to tell you how to increase the efficiency of your machine tools 25 to 100 per cent., we wish that you would read our Bulletin 101, "The Crank Shaper". It contains some real information—facts and figures that are the result of extensive and thorough tests.

Our Folder 10-M is interesting reading for motor users and we will gladly send copies for all of your engineers.

RELIANCE SERVICE

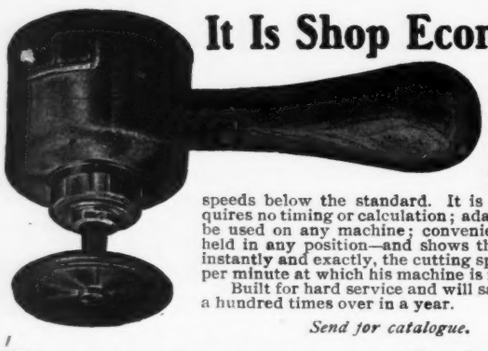
We are not electric motor manufacturers in the ordinary sense of the word but are specialists in complete motor equipments for Machine Shops. We furnish not only the motors but are also prepared to design and manufacture all brackets, gears, etc., for converting your belt driven tools to motor drive.

If you have work on which motors can be used to advantage, our engineers will gladly make a careful investigation of your needs. All we ask is an opportunity to show you what we have to offer as we are confident that sooner or later you will be convinced of the superior merit of Reliance Motors.

We manufacture Reliance Constant Speed Motors for either alternating or direct current service.

Reliance Electric and Engineering Co., 800 Huron Road, Cleveland, Ohio

It Is Shop Economy



to have a **Cut-Meter** for every machine tool. With this device at hand there is no excuse for speeds below the standard. It is simple, requires no timing or calculation; adaptable, can be used on any machine; convenient, can be held in any position—and shows the operator instantly and exactly, the cutting speed in feet per minute at which his machine is running.

Built for hard service and will save its cost a hundred times over in a year.

Send for catalogue.

Warner Instrument Company

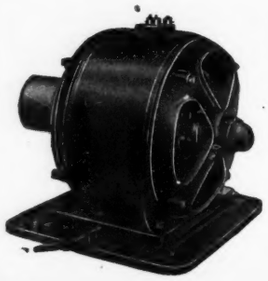
56-59 Roosevelt Avenue, BELOIT, WIS.

1781 Broadway, New York. 143 Federal Street, Boston.

Eck Dynamo and Motor Co.

BELLEVILLE, NEW JERSEY

Specialists in the manufacture of



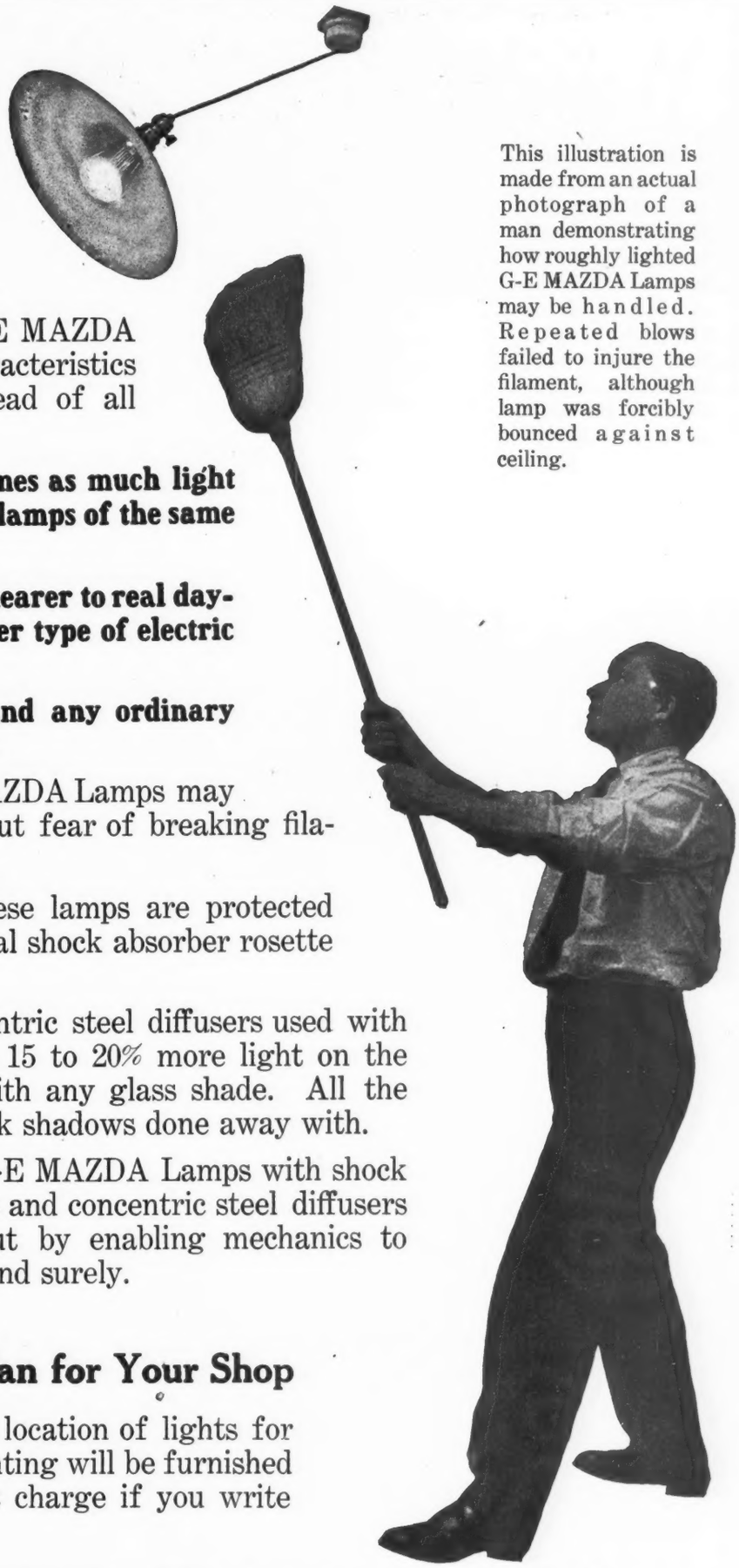
ELECTRIC MOTORS

for application to all classes of machinery.

1-32 to 20 H. P.

Tell us your needs.

Sturdy G-E Mazda Lamps Stand Rough Treatment



This illustration is made from an actual photograph of a man demonstrating how roughly lighted G-E MAZDA Lamps may be handled. Repeated blows failed to injure the filament, although lamp was forcibly bounced against ceiling.

For shop lighting G-E MAZDA Lamps have three characteristics that place them far ahead of all other illuminants.

1. They give three times as much light as ordinary incandescent lamps of the same current consumption.

2. They show colors nearer to real daylight values than any other type of electric incandescent lamp.

3. They will withstand any ordinary shock without breaking.

When lighted, G-E MAZDA Lamps may be roughly cleaned without fear of breaking filament.

When not lighted, these lamps are protected from vibration by a special shock absorber rosette on the ceiling.

The 16 and 21″ concentric steel diffusers used with these lamps reflect from 15 to 20% more light on the work than is possible with any glass shade. All the light is reflected and black shadows done away with.

The combination of G-E MAZDA Lamps with shock absorbing ceiling rosettes and concentric steel diffusers will increase your output by enabling mechanics to watch their cuts clearly and surely.

A Lighting Plan for Your Shop

showing size and location of lights for most efficient lighting will be furnished promptly without charge if you write at once.

GENERAL ELECTRIC COMPANY, Principal Office: **SCHENECTADY, N. Y.**

SALES OFFICES IN ALL LARGE CITIES

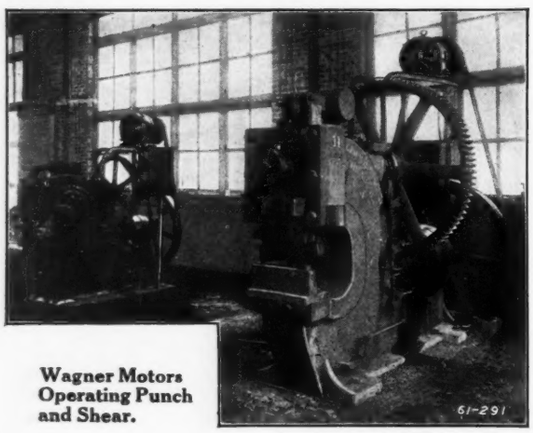
2612

WagnerElectric

Manufacturing Company, St. Louis, Mo.

The Wagner Single-Phase Motor

takes less current per line wire at starting and therefore disturbs less, the single-phase from which it takes **all** its current than a squirrel-cage motor disturbs each of its two or three phases. This is true even though the Wagner Single-Phase motor is thrown directly across the line without the intermediary of **any** starting device, while the demands of the squirrel-cage motor are moderated through an auxiliary auto-transformer.



Wagner Motors Operating Punch and Shear.

There is nothing novel about this statement. It has been advertised before and known for years. Let us send you, however, our Single-Phase bulletin which contains an excerpt from a paper read by the Manager of the Small Motor Department of one of our big competitors. The remarks in question outline clearly the present trend of opinion on the subject of single-phase distribution, particularly the change of sentiment on the part of manufacturers, who, unable to supply commercial single-phase motors have heretofore claimed the single-phased system to be uneconomical.

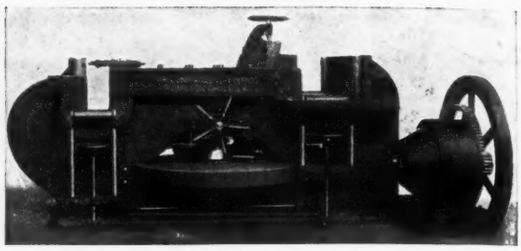
Wagner, Quality

Atlanta, Empire Bldg.
Boston, 110 State St.
Buffalo, 41-43 E. Eagle St.
Chicago, Marquette Bldg.
Cincinnati, First National Bank Building.
Cleveland, New England Bldg.
Denver, Gas & Electric Bldg.
Detroit, Union Trust Bldg.
Kansas City, 1113 Wyandotte St.
Minneapolis, Security Bank Bldg.
Montreal, Bell Telephone Bldg.
New Orleans, 205 Chartres St.
New York, 50 Church St.
Philadelphia, Real Estate Trust Bldg.
Pittsburg, Lewis Block.
St. Louis, 6400 Plymouth Ave.
San Francisco, Balboa Bldg.
Seattle, Pacific Block.
Sioux City, 515-517 5th St.

W WESTINGHOUSE ELECTRIC

Type "S"

Direct-Current Motors have stood the test of time



Westinghouse Type "S" Motor driving Horizontal Punch and Bender.

Their reliability under the severest operating conditions, their efficiency, durability, great overload capacity and low operating temperature are some of the reasons for their constantly increasing use. Type "S" Motors are made in standard capacities suitable for almost any possible demand and immediate shipment can be made from stock. The standard ratings range as follows:

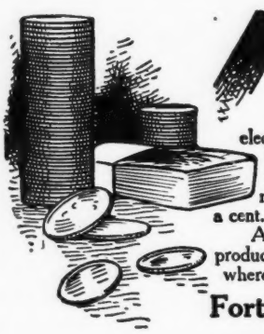
2 to 75 horsepower, 110 volts
2 to 150 horsepower, 220 volts
2 to 150 horsepower, 500 volts
6 to 100 horsepower, 600 volts

Special motors for higher voltages up to 650 can be supplied on order.

Full particulars in Circular 1068.

Westinghouse Electric & Mfg. Co.

Sales Offices in all large cities. Pittsburg, Pa.



Motor Profits

Before you spend much money for electrical equipment you probably want to know what interest you will make on your investment. This can be determined quite accurately before you spend a cent.

Anything that reduces your unit cost of production means additional profit and here is where

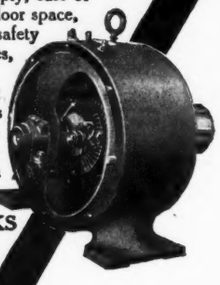
Fort Wayne Motors Prove Their Superiority

We will be glad to furnish you with guarantee performance curves for any of our motors and if you will send us your specifications our engineers will solve your individual problems and recommend sizes, etc.

With this information you can easily figure out how much you will gain by installing electric drive in **your** plant.

There are a great many advantages also on which it is hard to place a **money** value, such as cleanliness, convenience of locating machines regardless of power supply, ease of control, automatic operation, economy of floor space, elimination of belts and pulleys, increased safety and freedom from accidents to employees, more light and less noise.

These points apply in general to almost all motors but there are particular features about Fort Wayne Motors that make them the **best purchase on** the market. Anyway it will pay you to send for our Bulletin "Motor Drives." It's free.



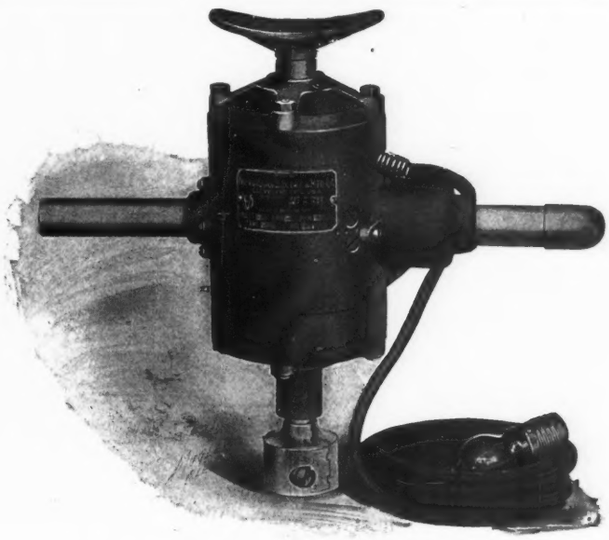
FORT WAYNE ELECTRIC WORKS

"WOOD SYSTEMS"

1616 Broadway, Fort Wayne, Ind.

M12 Branch offices in most large cities

Van Dorn *Quality*



Type D No. 0 Hard Service Electric Drill ½" Cap.

The drill you will eventually buy—has four-pole railway type motor entirely form wound. Armature runs on ball bearings—pressed steel head and gear case. Made in six sizes, 0 to 2″ capacity.

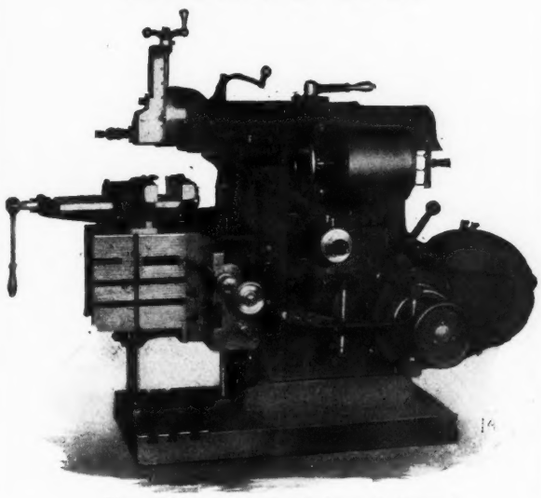
ELECTRIC DEPARTMENT

THE VAN DORN & DUTTON COMPANY

CLEVELAND, OHIO

NEW YORK PITTSBURGH CHICAGO SAN FRANCISCO

We've never found a machine tool



Shaper driven by a **C-W** *Form 1 Motor*

that could not be driven economically by a **C-W** motor. We have specialized in this line since 1888.

CROCKER-WHEELER COMPANY

Motor-Drive Experts

AMPERE, N. J.

The "Hisey" Patented Automatic Switch

marks the greatest advancement ever made in portable electric drills. Operator has drill under control at all times. Fused attachment plugs are furnished, protecting motors from overload. Investigate the "Hisey"—the most advanced of all portable electric tools.

Drills and Grinders for every class of work.

Write for Catalog No. 7.

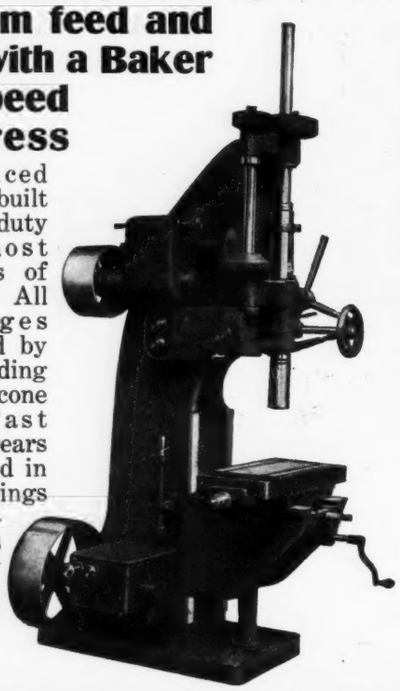
All motors air cooled. Any standard tool sent on ten days' trial. Immediate delivery on all orders.

THE HISEY-WOLF MACHINE COMPANY

CINCINNATI, OHIO

New York Office, 50 Church Street

You can drive any High Speed Drill from ½" to 1½" at its maximum feed and speed with a Baker High Speed Drill Press



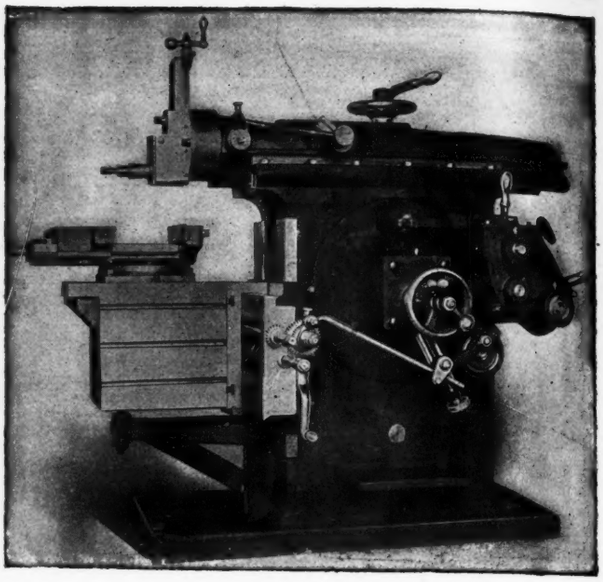
This advanced machine is built for severe duty and the most rapid lines of drilling. All speed changes are obtained by means of sliding gears—no cone pulleys. Fast running gears are immersed in oil; all bearings bronze bushed, all shafts carefully ground.

Full description in the Catalogue.

BAKER BROTHERS

TOLEDO, OHIO, U. S. A.

FOREIGN AGENTS: Schuchardt & Schutte, Berlin, Vienna, Stockholm. A. H. Schutte, Cologne, Paris, Brussels, Liege, Milan. Chas. Churchill & Co., London and Manchester.

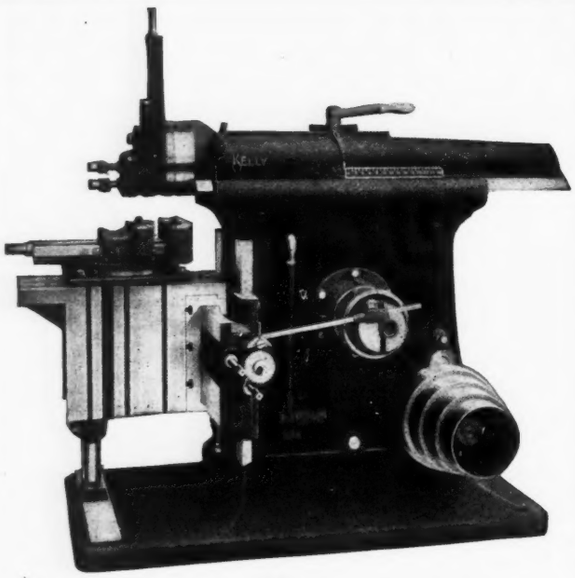


16-INCH SHAPER

The driving mechanism of Flather Shapers is more powerful and uniform than any other shaper in the market and we welcome an opportunity to prove it.

The Mark Flather Planer Co.

NASHUA, N. H.



Kelly Crank Shapers will Plane to an Exact Line

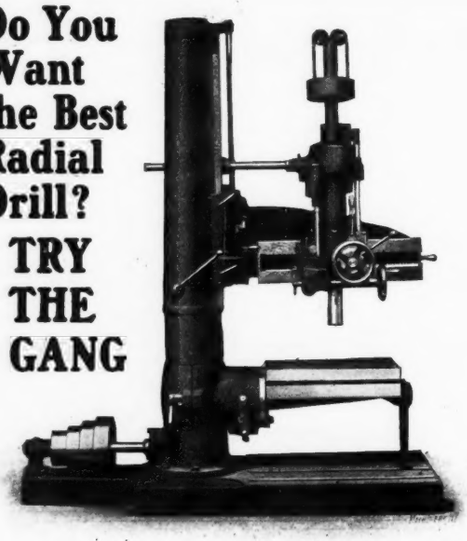
day after day, year after year, their hand scraped bearing surfaces being as perfect as human ingenuity can produce.

Adapted to a wide range of general and special work there is no machine tool you can better afford to give floor space in your shop.

Write for new catalogue.

THE R. A. KELLY CO., Xenia, Ohio

Do You Want the Best Radial Drill? TRY THE GANG



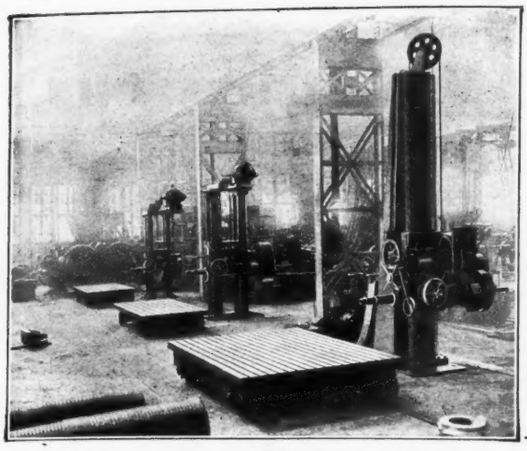
It has the most direct drive of any machine of its class—is more easily controlled—has capacity for a wide range of work—strength and rigidity for heavy cuts. All our machines are compact in shape and without complicated mechanism.

Write for special details.

THE WM. E. GANG CO., Cincinnati, Ohio

Domestic Agents—Hill, Clarke & Co., Boston, Chicago, Philadelphia and New York. C. H. Wood Co., Syracuse, N. Y. Baird Mchy. Co., Pittsburg, Pa. Miller Supply Co., Huntington, W. Va. W. M. Pattison Supply Co., Cleveland, O. Osborne & Sexton Mchy. Co., Columbus, O. W. R. Colcord Mchy. Co., St. Louis, Mo. Perine Mchy. Co., Seattle, Wash. Hewitt Mchy. Co., San Francisco, Cal.

Foreign Agents—The Canadian Fairbanks Co., Ltd., Dominion of Canada. Sanford & Co., Monterey, Mexico. Limbourg Freres, Brussels, Belgium. Adler & Eisenschitz, Milan, Italy. Buck & Hickman, London, England. V. Lowener, Copenhagen, Denmark. C. A. Swensson & Co., Stockholm, Sweden. Axel Christiernsson, Abo, Finland.



HORIZONTAL
DRILLING AND BORING MACHINES

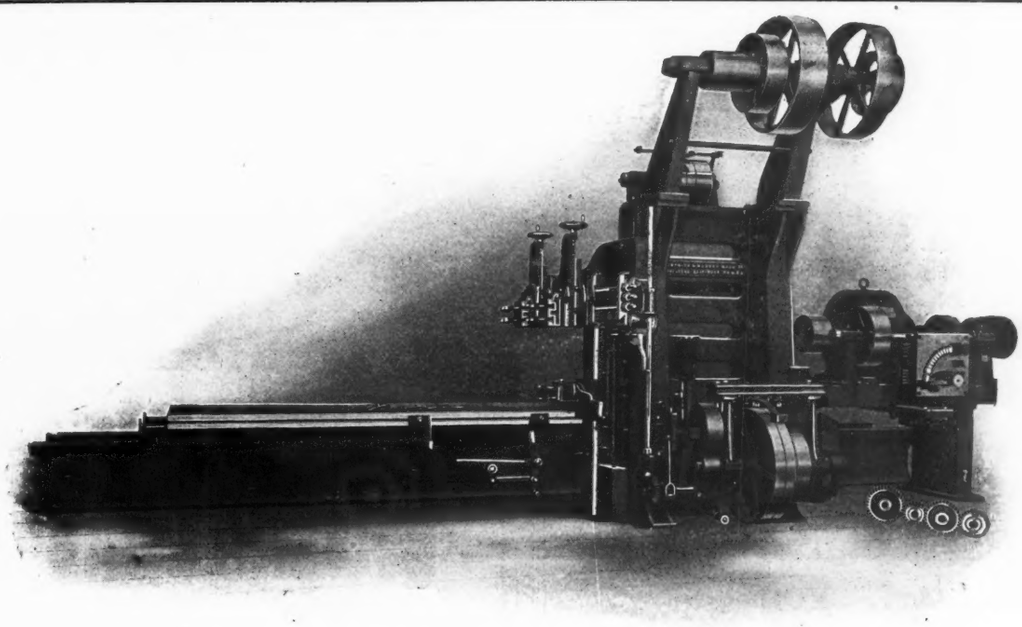
We have sold more of our drills right here in our home city than in any other single place in the country. And, as a rule, a manufacturer's home town is his poorest market.

Milwaukee is a great machinery and tool center. The manufacturers of this city know when a machine or tool is all right and when it is not up to the mark.

When such concerns as the Allis-Chalmers Co., the Nordberg Mfg. Co., the Fred. M. Prescott Steam Pump Co., the Bucyrus Co., the Vilter Mfg. Co., the Chicago, Milwaukee & St. Paul R.R. and others, too numerous to mention in this limited space, recommend our drills as highly as they do, the machine comes pretty near to being *"just right"*.

May we send our Catalog?

PAWLING & HARNISCHFEGER COMPANY
MILWAUKEE, WISCONSIN



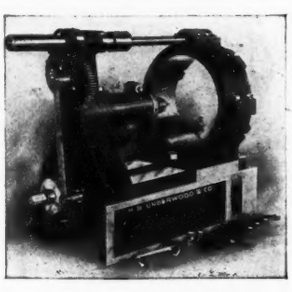
THE OPEN SIDE PLANER with Variable Speed Motor Drive.

Standard sizes: 30", 36", 42", 48", 60" and 72".

THE DETRICK & HARVEY MACHINE CO., Baltimore, Md.
Makers of
Horizontal Drilling, Boring and Milling Machines

FOREIGN REPRESENTATIVES:—Ludw. Loewe & Co., Berlin, Germany. Paul Auriol, Paris, France. Wilh. Sonesson & Co., Malmo, Sweden. Chas. Churchill & Co., London, England.

PORTABLE TOOLS SAVE THEIR COST



They eliminate dismantling and erecting and cut down the time the machine is out of operation, which is the most expensive item.

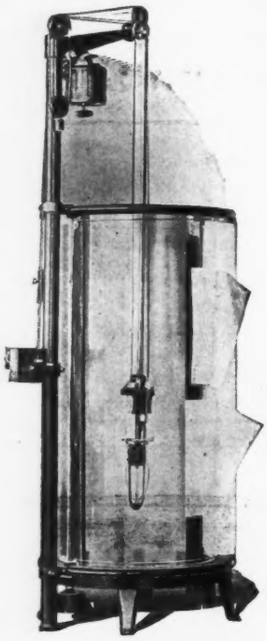
You don't send your piano to the factory to be tuned.

Don't dismantle your engine to have the crank pin trued up.

The illustration shows our machine, several of which we recently built, for truing up 20" diameter Crank Pins.

Our catalog shows smaller sizes and also our Portable Cylinder Boring Bars, etc. *Write for it.*

H. B. UNDERWOOD & CO., 1024 Hamilton Street, Philadelphia, Pa.



Style A—2 prints 42 x 44
Style B—2 prints 42 x 60
Style C—2 prints 42 x 72

What is Time Worth to You?

Time lost waiting for blue prints on a cloudy day can never be regained.

You can save at least 27 minutes per half hour in getting important blue prints to the shop by using a

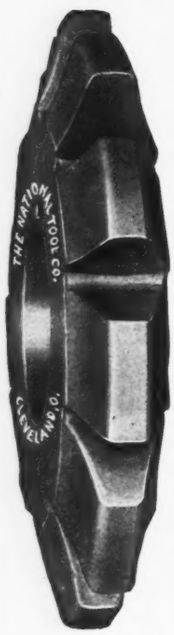
BUCKEYE ELECTRIC BLUE PRINTING MACHINE

Multiply this 27 minutes by the wages of the machinist, the cost of having that large tool stand idle, the time of the blue print maker and the number of delays; then it is plain why the simplest blue print machine on the market will pay for itself in 6 months. Over 500 of the leading manufacturers have adopted it. *Write us, and we'll tell you all.*

BUCKEYE ENGINE CO., Salem, Ohio

Specialty Department

Be Particular About the Cutters you Use



Most cutter troubles come through being satisfied with "Oh, I guess they are all alike."

They are not!

At least they are not like the

National Milling Cutters

for many good *working* reasons.

We make National Cutters of high speed steel or carbon steel, all styles—all sizes. You'll notice the difference between them and "the others" after you have tried them.

Send for price list.

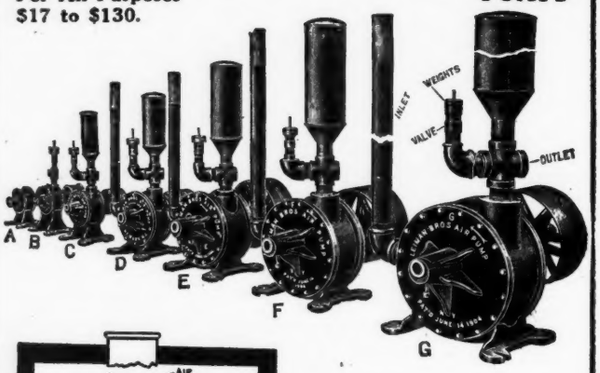
THE NATIONAL TOOL CO.

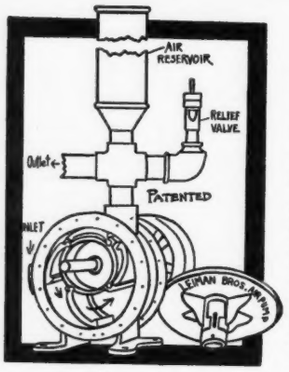
CLEVELAND, OHIO, U. S. A.

LEIMAN BROS.

BLOWERS & VACUUM PUMPS

For All Purposes $17 to $130.

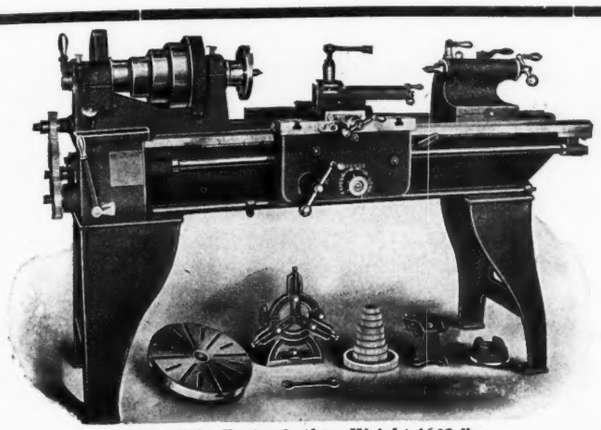




Take up their own wear. Noiseless, Durable, Powerful. Simple construction with few working parts, and these all large and strong. Small piston gives big space for displacement or volume of air. Wings are detachable and interchangeable. Centrifugal force holds them against the cylinder, (see cuts for direction of rotation). No delicate or intricate parts to break or get out of order. No separate tips on the wings. Small yet firm contact of wings with cylinder reduces friction. Shaft well oiled by double ring-oiling device. High vacuum and steady pressure. No fluctuation.

Send for particulars and illustrations stating how the machines are to be used.

LEIMAN BROS., Leiman Building 62 E John St. NEW YORK



14 in. x 6 ft. Engine Lathe. Weight 1630 lbs.

The Seneca Falls Mfg. Company

330 Water Street, Seneca Falls, N. Y., U. S. A.

Manufacturers of

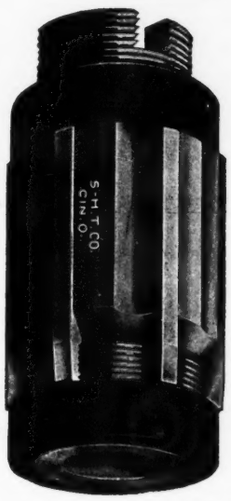
12", 14", 16" Engine Lathes

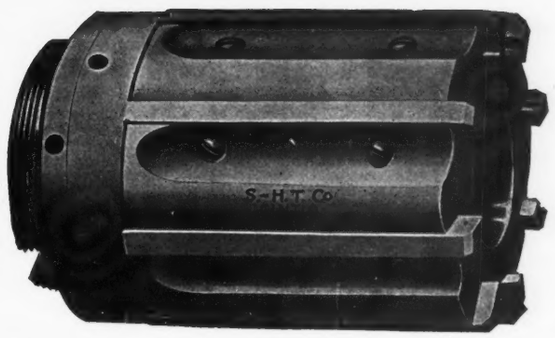
Powerful—Heavy—Rigid—Built on common-sense lines for hard-every-day service—profitable service—and to meet most severe exactions. Rapid—Accurate—Convenient—Durable. *Described in catalog "B." Send for it.*

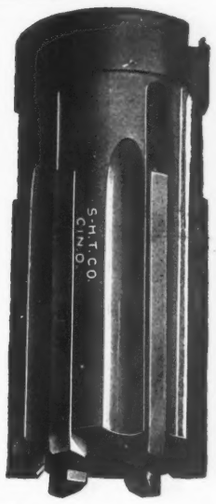
We also make 9 in. 11 and 13 in. Star Engine Lathes, 10 in. and 12 in. Speed Lathes, 9 in. Bench Lathes, 10 in. Wood Turning Lathes, Foot Power Lathes.

122 A

UNIVERSAL ADJUSTABLE TOOLS







The universal adjustable cutter boring heads and reamers make an ideal combination for standardizing holes economically. The boring heads are furnished with high speed steel cutters. They are quickly and accurately adjusted, permitting a close maintenance to size. The large range of adjustment allows one tool to be used for a number of sizes either standard or fractional. The reamers are furnished with either carbon or high speed steel blades as ordered.

"Ask the man in the shop" Catalogue upon request

The Schellenbach-Hunt Tool Co., Cincinnati, Ohio

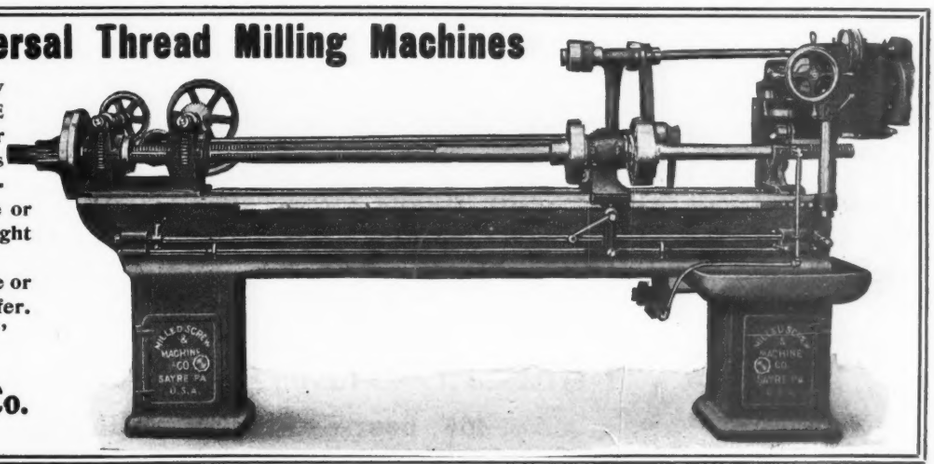
The American Specialty Company, Chicago, Ill., Agents for the Chicago District.

FOREIGN AGENTS: C. W. Burton, Griffiths & Co., London, England. Markt & Co., 193 West St., New York, Germany and Italy. New York Export & Import Co., 133-137 Front St., New York, China, Japan and Australia. Williams & Wilson, Montreal, Canada. J. S. Cock, Christiania, Norway.

Automatic Universal Thread Milling Machines

Simple construction, few parts and patented DOUBLE WORM DRIVE reduce power expenses. Special methods insure the most accurate product. Threads of any shape or angle, single or multiple, right or left hand.

We will SELL the machine or CUT your screws, as you prefer. "Visitors always welcome."



Milled Screw and Machine Co.

SAYRE, PA.

The Strength, Toughness and Durability of a Celfor High Speed Twist Drill

CELFOR

is many times greater than a milled drill of the same diameter. Celfor Drills are twisted while hot in machines especially designed for the purpose, a process by which the continuity of the fibre of the steel is preserved, and the maximum strength secured. There is ample space for chip clearance in operation and the drill can be ground so that large holes may be drilled from the solid without first drilling lead holes.

They are durable, stand constant service without deterioration and are particularly well adapted for special and exceedingly rapid drilling. Catalogue No. 10 shows full line of tools.

CELFOR TOOL COMPANY
BUCHANAN, MICH., U. S. A.

HIGH SPEED TWIST DRILLS

Made from Round Bars

Made from Flat Bars

Hot Forged, Cleared, Tempered, Sand Blasted and then ground to Micrometer Caliper Gauge.

Result

Best and strongest Drills on the market.

New Process Twist Drill Co.
TAUNTON, MASS., U. S. A.

Acme High Speed Twist Drills and Patent Sockets

NEWEST — BEST — STRONGEST — LONGEST LIFE—MOST ECONOMICAL

The Acme is without doubt the **very best** and **latest improved high speed drill** on the market, and, when used with the **patent Acme Socket,** is positively the **strongest** and **most durable,** and **more economical** than any or all others. It assuredly fills a want long felt by all users of high speed drills.

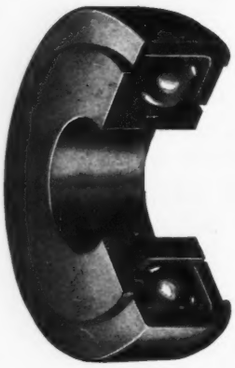
We make these **strong claims to superiority,** fully aware of similar claims for other drills. To prove our claims we suggest that you order at once a **Drill** and **Patent Socket,** thoroughly try it out on your toughest work in competition with the very best drills made, and if it does not prove more than satisfactory, return to us. We have not space here to say more.

Send for special circular and price list.

ACME DRILL COMPANY
3 and 5 Scott Street, NEWARK, N. J.

Our Solid Cone Combination

BALL BEARINGS



are made for shafts ⅛" up to 2 5/16". Cone, cup and balls are all combined, and the balls cannot fall out. Used on all kinds of machinery. *Send for Catalogue R.*

PRESSED STEEL MANUFACTURING CO.
454 Bourse Building, PHILADELPHIA, PA.

"The Reeves"

WOOD-SPLIT PULLEY

This Pulley Will Transmit 20 to 100% More Power

Let us *prove* it to you. It is 50 to 75% lighter in weight than metal pulleys. Let us prove *that* to you. It costs considerably less power to turn than a heavier metal pulley. *That* needs no proof.

It can increase its speed to 3.25 times that of a sound cast-iron pulley, with equal safety.

Wm. A. Kent, A. M., M. E., demonstrates *that* fact in the "Mechanical Engineer's Pocket Book", in his authoritative article on "A Wooden-Rim Fly-Wheel."

Its infinitely painstaking, bit-by-bit construction of both rim and arm, the two becoming integral in the most scientific way, allows of—and demands—the most rigid, frequent and detailed inspection, whereas the inspection of a metal pulley can only be superficial.

Isn't *that* self-evident?

If you have only *one* pulley, we can give you the best reasons in the world why it should be "The Reeves" Wood-Split Pulley. *Send for our Pulley Cata logue—It TALKS.*

REEVES PULLEY COMPANY

COLUMBUS, IND., U. S. A.

BRANCH HOUSE: Cor. Clinton and Monroe Sts., Chicago

Do You Want to Drill at the Lowest Possible Cost?

If so, there is only one Twist Drill to use and that is the

"HERCULES" High Speed

It is twisted from the Latest Improved Vanadium High Speed Steel and is the strongest and toughest twist drill made to-day.

All we ask is a chance to show you what the "Hercules" will do.

TRADE MARKS

W&B

The "Hercules" is fitted with Taper Shanks, usually one size larger than regular.

These large Shanks give extra driving power.

The Whitman & Barnes Mfg. Company

AKRON, OHIO, U. S. A.

Factories:

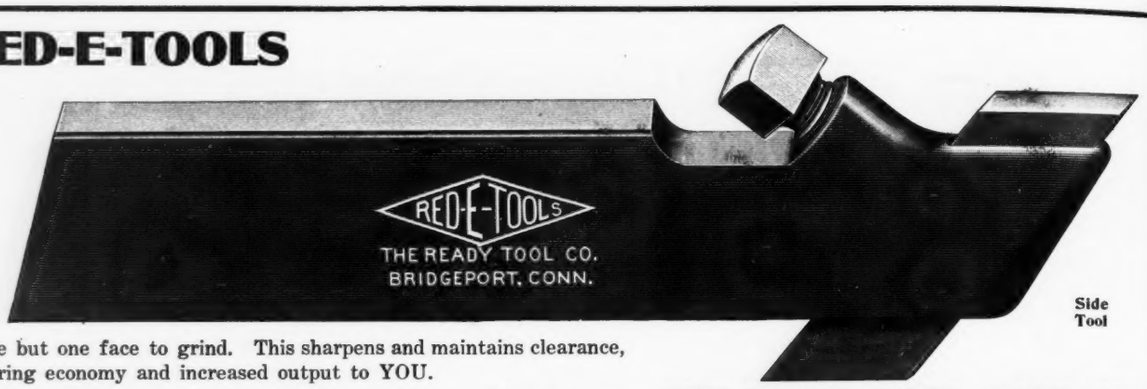
Akron, Ohio Chicago, Ill. St. Catharines, Ont.

NEW YORK STORE, 64 READE STREET

European Representative—THEODORE BUTLER, Ltd., 149 Queen Victoria St., London, England.

Export Sales Agent—A. J. BARNES, 99 West St., New York, N. Y.

RED-E-TOOLS



Side Tool

Have but one face to grind. This sharpens and maintains clearance, assuring economy and increased output to YOU.

Made right hand, left hand, and right hand off-set. Other features of merit described in catalogue No. 25. *Write for it NOW.*

THE READY TOOL COMPANY
BRIDGEPORT, CONN.

SHAPERS

14-inch to 32-inch Stroke.

Crank and Triple Geared.

John Steptoe Shaper Company, Cincinnati, Ohio.

WORCESTER DRAFTING TABLE

The tops of these tables are white pine drawing boards and can be inclined and clamped at any angle. The adjustment for height is by means of the hand wheel which is automatically locked at the desired height.

THE WASHBURN SHOPS
of the
Worcester Polytechnic Institute, Worcester, Mass.

Worcester Drill Grinders — Washburn Speed Lathes
Washburn Sensitive Drills — Worcester Drafting Tables

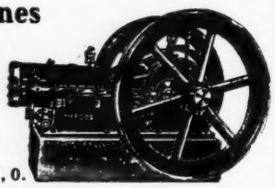
FOOS

Gas and Gasoline Engines

POINTS OF SUPERIORITY:

1. Wipe Spark Igniter—Automatically cleans the contact points, insuring perfect spark action.
2. Centerline Disc Counterbalance—Fitted to the throws of the crank shaft, insuring smooth running and durability of the crank shaft.
3. Vertical Valves do not wear on their stems and guides, insuring against leakage.

Send for Catalogue No. 49.



THE FOOS GAS ENGINE CO., Springfield, O.

NOT IN A TRUST

HAYES FILE COMPANY, - - DETROIT, MICHIGAN

Use our SPECIAL SOLDER-CUT File, for filing Solder.

Two-year practical courses in

Steam and Machine Design
Applied Electricity
Applied Chemistry

One-year courses in

Machine Construction
Carpentry and Building

Write for catalog and particulars

PRATT INSTITUTE
Low Tuition. **BROOKLYN, N. Y.**

SHAPERS

EXCLUSIVELY.

12 TO 32 INCH STROKE.

Smith & Mills Co.
Cincinnati, Ohio, U. S. A.

FOREIGN AGENTS: C. W. Burton, Griffiths & Co., London. G. & F. Limbourg Freres, Brussels. Van Rietschoten & Houwens, Rotterdam. Glaenzer, Perreaud & Thomine, Paris. Stussi & Zweifel, Milan.

CUT WELD REPAIR

all Steel Castings, Machinery, Metals, with the

Oxy-Acetylene Torch

"A Putting-on-Tool"

Write for information about this interesting process—NOW.

Davis-Bournonville Co.
97 West Street, New York

You Can't Get Stuck with this Ratchet.

Two inches of motion at end of handle, IN ANY DIRECTION, will drive the Drill.
Patented Nov. 8, 1898, Sept. 29, 1903.
When the other ratchets you have are useless for lack of room to move the handle, get an "ARMSTRONG UNIVERSAL" and it will do the job.

Write for Catalog.

Armstrong Bros. Tool Co., "The Tool Holder People."
313 N. Francisco Ave. CHICAGO, ILL., U. S. A.

See our Tool Holder ad., page 121

DON'T SCRAP YOUR CASTINGS

Most defective castings—Those with cracks, blow holes, etc.—can be permanently repaired with NATIONAL IRON FILLER CEMENT. Get a free sample and circular 109-P telling all about its uses.

The S. Obermayer Company
Cincinnati Chicago Pittsburgh

Back Numbers of Magazines

trade papers and newspapers supplied at moderate rates. Clippings of special subjects furnished promptly. Magazines of all kinds bought. Cut rate subscription price list furnished on request.

A. W. CASTELLANOS
264 Armstrong Ave. JERSEY CITY, N. J.

Bound Volumes of Machinery

THE INDUSTRIAL PRESS
49-55 Lafayette St. - New York

Do You Use Reamers?

The McCrosky Adjustable Reamer will solve your reaming problem. Send us a trial order and make us prove it. All styles and sizes from ¾" up. Highest quality, prompt delivery and satisfaction guaranteed are the grounds on which we seek your business.

We can give you a long list of the biggest and best shops in the country that have adopted the McCrosky Reamer as standard equipment. **We had to "show" them first.**

A Reamer Combining the Advantages of both Solid and Adjustable Types. Principle of Construction Unequaled. Workmanship and Material Unexcelled.

Simplest and strongest; no internal mechanism to weaken it; no screws or small parts to get out of order; chip clearance perfect; will bottom a blind hole; has large and accurate adjustment; can not change its size in the hole or by careless usage; blades readily renewed and one Reamer will outwear a dozen solid reamers.

A postal card inquiry will get you detailed information on reamers that will save you money.

THE McCROSKY REAMER CO., Inc., Meadville, Pa.

Successors to F. B. McCROSKY MFG. CO.

Duplex
Drawing Paper

has long been recognized by draftsmen throughout the country as the standard for machine drawing. It is tough and hard, and absolutely uniform in quality.

The erasing qualities of Duplex paper are unsurpassed. Successive erasures may be made over the same spot until the thickness of the paper is reduced to that of tissue paper, and it will still take ink and pencil as perfectly as on the original surface.

Another advantage of Duplex is the cream or buff color, which is agreeable to the eye and permits the paper to be handled without soiling.

Send for a free sample of Duplex paper and test its good qualities yourself.

KEUFFEL & ESSER CO.

127 Fulton Street NEW YORK — **General Office and Factories HOBOKEN, N. J.**

CHICAGO 111 E. Madison St. — ST. LOUIS 813 Locust St. — SAN FRANCISCO 48-50 Second St. — MONTREAL 252 Notre Dame St W

Drawing Materials, Mathematical and Surveying Instruments, Measuring Tapes

TRADE "BETTER THAN DAYLIGHT" MARK

COOPER HEWITT LAMP

An Array of Facts:

Theories are good for the inventor and the scholar, but facts are what you want when you are estimating on a job. You always give yourself the benefit of the doubt, with a liberal margin of safety.

Here are the facts concerning the Copper Hewitt Lamp, proven beyond doubt and stated with a hundred per cent margin of safety.

The Cooper Hewitt Lamp gives a light of an entirely different quality from any other light-source, because the light comes from a luminous vapor instead of a luminous solid.

The quality of light from the Cooper Hewitt is such as to enable the eye to distinguish finer details than is possible with any other light, not even excepting daylight.

You can see objects plainly in a much dimmer light from the Copper Hewitt Lamp than from any other light-source; hence there are no shadows that you cannot see to work in.

The light of the Cooper Hewitt Lamp contains no red rays, which are heat-producing and irritating; hence is the easiest of all lights on the eyes.

The Cooper Hewitt Lamp is the CHEAPEST of all electric lamps to operate and maintain; lamps frequently run two or three years without other attention than an occasional wiping off of the tubes.

Put this array of facts to any test you please,—the harder the better, so far as we are concerned.

Cooper Hewitt Electric Co.

220 West 29th St., New York.

Albany, N. Y. . . . . 66 State St.
Boston, Mass. . . . . 161 Summer St.
Chicago, Ill. . . . . 40 Dearborn St.
Cincinnati, O. . First Nat'l Bank Bldg.
Cleveland, O. . American Trust Bldg.
Detroit, Mich. . . . 518 Moffatt Bldg.
Minneapolis, Minn. . Met. Life Bldg.
Philadelphia, Pa. . . 124 So. 8th St.
Pittsburg, Pa. . . . Wabash Bldg.
St. Louis, Mo. . Missouri Trust Bldg.

Make "Absolute Accuracy" a Shop Order With You

Stick it on the order sheets and on the walls. Make it a war cry. Then you'll begin to cut costs. You can't do it with the ordinary shop caliper, but you can with Slocomb Micrometers, because they give absolute accuracy in all measurements.

They are proof against wear and variation. The extra long bearing between nut and screw prevents wearing out of pitch—even after years of hard service.

157 Styles and 44 Sizes. Send for Measuring Book and Catalogue No. 12.

J. T. SLOCOMB CO., Providence, R. I.

Sole Agents for Great Britain: Chas. Churchill & Co., London, Birmingham, Manchester, Newcastle-on-Tyne and Glasgow.
Ludw. Loewe & Co., Berlin, Agents for Continental Europe

Catalogs furnished on request.

BARGAINS NEW AND SECOND HAND MACHINERY TOOLS AND SUPPLIES

REFITTED MACHINE TOOLS

DRILL PRESSES (Upright).
2—Dallett Portable.
1—6-spindle Quint Turret.
1—26″ Prentice Sliding Head.
1—33″ Bement-Niles.

RADIAL DRILLS.
1—42″ Prentice Gear Box.
1—4′ Box, Half Universal.
1—4′ 6″ Pond Heavy.

GEAR CUTTERS.
1—33″x9″x4 P. Gould & Eberhardt.
1—48″x10″x3 P. Gould & Eberhardt.

GRINDERS.
1—No. 1 Cincinnati Cutter Grinder, complete.
1—No. 1 Leland & Faulconer Wet Tool.
1—No. 2 Leland & Faulconer Wet Tool.
1—"A" Yankee Drill Grinder.
1—"PO" Yankee Drill Grinder.
2—No. 11 Brown & Sharpe.
1—No. 4 Landis Universal.
1—No. 24 Landis Plain.

HAMMERS.
1—60 lb. Bradley Cushion Helve.

KEYSEATERS.
1—24″x2″ Morton.

LATHES (Engine).
1—13″x6′ Bullard, with turret.
1—14″x8′ Flather Four Step Cone, elevating rest.
1—16″x8′ Greaves & Klusman, compound rest, taper attachment.
1—18″x10′ Porter, compound rest.
1—20″x8′ Flather Four Step Cone, belt feed, compound rest.
1—20″x8′ Flather Five Step Cone, belt feed, compound rest.
1—22″x12′ Lathe & Morse Four Step Cone, belt feed, compound rest.
1—22″x15′ Pond, compound rest.
1—24″x12′ Lodge & Shipley Five Step Cone, compound rest, quick change.
1—48″x20′ Johnson Triple Geared Massive.

LATHES (Polishing).
1—No. 3 Diamond.

MILLING MACHINES.
1—No. 3½ Garvin Plain.

PLANERS.
1—10″ Busch Crank, swivel vise.
1—20″x20″x4′ Wheeler, one head.
1—24″x24″x6′ Ohio, one head.
1—24″x24″x6′ Whitcomb, one head.
1—27″x5′ New Haven, one head.
1—30″x10′ Detrick & Harvey Open Side.

PRESSES.
1—P-4 Ferracute.
1—No. 62 Toledo Triple Geared.

SHAPERS.
1—15″ Hendey.
1—15″ Smith & Mills Single Geared Crank.
1—16″ Steptoe Crank.
1—16″ Gould & Eberhardt Crank.
1—20″ Hendey Friction.
1—20″ Kelly Crank.
1—24″ Ohio Shifting Belt.
1—26″ Cincinnati Shifting Belt.
1—28″ Hendey Friction.

TURRET LATHES.
1—7x14 Potter & Johnston.
1—8½x16 Potter & Johnston.
1—22″ Universal, chuck fitted.
1—24″ Lodge & Shipley Screw Machine.
1—28″ Gisholt, rapid traverse.
1—44″ Grant Chucking Lathe.

MISCELLANEOUS.
1—1½″ 6-spindle Acme Nut Tapper.
1—No. 1 Caskey Pneumatic Punch.
1—10″x37″ Chicago Pneumatic Gap Riveter.
1—17″Peerless Belt Lacer.

The Motch & Merryweather Machinery Co.

707-711 Lakeside Ave., N.W., Cleveland, O. Detroit Branch: 1025 Majestic Bldg. Cincinnati Branch: 1014 First Nat'l Bank Bldg Pittsburg Branch: 1124 Farmers Bank Bldg.

IMPORTANT if low in price

J. J. McCABE'S MACHINES ARE

Never in our recollection have we been able to offer more attractive machinery.

LATHES.
Triple Geared.
100″x30′, Bement.
84″x24′, Boston.
82″ Pit Lathe, T-stock and Carr.
64″x36′, Bement.
60″x18′, Fitchburg.
54″x21′, Fitchburg.
52″x28′, Hewes & Phil.
50″x32′, Putnam.
34″x12′, Fitchburg.
38″x12′, Gleason.
48″x24′, Fitchburg.
48″x16′, Putnam.
Back Geared.
38″x16′, Fifield, B.G.
37′x20′, Risers 43″, American.
76″ Dble-hd. Driving-wheel Lathe, Bement.
32″x13′, Pond, B.G.
30″x23′, Pond.
30″x17 1-2′, Pond.
28″x15′, Worcester.
28″x14′, Harrington.
27″x20′, Pond.
26″x13′, Bement, Taper.
26″x12′, Niles.
25″x16′, Lathe & Morse.
25″x14′, Blaisdell.
24″x10′, Standard.
22″x10′, Pond.
21″x10′, Putnam.
20″x12′, Pond.
20″x9′, Pond.
20″x8′, Draper, Qk-chg.
18″x8′, Reed, Pl-Rt.
18″x8′, Putnam.
16″x8′, Bogert, Pl. Rt.
16″x6′, Qk-chg, Morris.
16″x6′, Putnam.
14″x6′, Reed.

PLANERS.
72″x26′, Sellers, 4 Hds.
72″x18′, Bement, 4 Hds.
54″x16′, Sellers, 4 Hds.
50″x16′, Bement, 2 Hds.
42″x18′, Niles, 2 Hds.
37″x11′, Niles, 3 Hds.
36″x11′, Sellers, 2 Hds.
36″x10′, Bement, 2 Hds.
36″x9′, Sellers, 2 Hds.
36″x8′, Pond, 2 Hds.
36″x8′, Pond, 1 Hd.
35″x12′, New Haven, 2 Hds.
34″x14′, Gleason, 1 Hd.
32″x10′, Pond, 2 Hds.
30″x8′, Fitchburg, 1 Hd.
30″x7′, Sellers, 2 Hds.
27″x7′, New Haven, 1 Hd.
26″x6′, Putnam, 1 Hd.
24″x6′, Pond, 1 Hd.
17″x4′, Miles, 1 Hd.

BORING MACHINES.
Upright.
10′, 2 Hds., Niles.
7′, 1 Hd., Bement.
6′, 2 Hds., Sellers.
5′, 2 Hds., Niles.
4′, 2 Hds., Colburn.
3′, 1 Hd., Bullard.
Horizontal.
Floor Boring Machine, Dble. Column and att., Niles.
2 7-8″ spindle, Bement.
2″ spindle, Sellers.
1 1-4″ spindle, Garvin.

DRILLS.
Radial.
144″ Plain, Baush.
132″, Plain, Sellers.
120″ Full-univ., Warren.
110″ Full-univ., Bement-Miles.
Upright.
50″, Harrington.
40″, Prentice.
38″, New Haven.
36″, Pond.
32″, Pond.
28″, Snyder.
25″, Barnes.

MISCELLANEOUS.
32-50″ Gap. Tur. Lathe, Gisholt.
32″ Gap. Tur. Lathe, American.
27″ Gap. Tur. Lathe, American.
24″ Gap. Tur. Lathe, Gisholt.
2 1-4″ Wire fd. Screw Mch., Pratt & Whit.
16″ Slotter, Sellers.
12″ Slotter, Bement.
11-2″ Bolt Cutter, Acme.
1″ Bolt Cutter, Acme.
12″ stroke Key-seater, Newton.
3″ Cutting-off Machine, Pratt & Whitney.
1,250 lb. Steam Hammer, Bement.
4,000 lb. Steam Hammer, Bement.
34″x11′ Slab Miller, Newton.
22″x5′ Slab Miller, Ingersoll.
Lincoln style, Garvin.
26″ Crank Shaper, Prentiss.
20″ Friction Shaper, Putnam.
15″ Crank, Gould & Eberhardt.
14″ Fitchburg, Traveling-head.
4″ Pipe Machine, Phila.
30″ Gear Cutter, Gould & Eberhardt.
No. 172 Spur Cutter, Bliss.
Auto. Surface Grinder, Walker.
Univ. Cutter and Tool Grinder, Cincinnati.
6 H. P. Gas Engine, White & M.

RAILROAD TOOLS.
Driving-wheel Lathe, 70″ Double-head.
Car-wheel Grinder, Double-head.
Double-end Axle and Centering Machine.
Double-head Axle Lathe, 27″ Bridgeford.

BRIDGE AND BOILER TOOLS.
10′ Bending Rolls, Hinged Housing.
6′ Bending Rolls, Solid Housing.
24″ Punch and Shear, Single, heavy.
9″ Punch and Shear, Hilles & Jones.

J. J. McCABE, 30 Church St, New York City

TECHNICAL BOOKS

WE are particularly strong on books pertaining to Steam Engineering, Heating, Ventilating, Power Plants, Boilers, Piping, Engines, Turbines, Condensers, Heaters; including Theory, Practice, Design and Operation; both Elementary and Advanced.

WRITE US FOR ANYTHING IN THIS LINE

The Technical Press

Brattleboro Every mechanical engineer should be on our list to receive new and important announcements. **Vermont**

FOR SALE

Some large and modern up-to-date Machine Tools at very attractive prices.

10′ Betts Vertical Boring Mill, two heads, practically new, having been used only three months.
60″ x 22′ Open Side Detrick & Harvey Planer, three heads, in first-class condition.
1500 lb. Bement Miles Double Frame Steam Hammer in first-class condition.
24″ x 20′ Lodge & Shipley Lathe.
No. 2 Cincinnati Universal Milling Machine.
Two No. 2 Brown & Sharpe Plain Milling Machines.
Two No. 1 Brown & Sharpe Universal Milling Machines.
36″ x 12′ Heavy Duty Slab Miller.
750 lb. Bement Miles Double Frame Steel Working Tilting Hammer.
No. 2 Baker Keyseater with circular table.
24″ x 22′ F. E. Reed Lathe.
60″ New Haven pulley turning or chucking lathe.
50″ Bement double head boring mill.
26″ x 26″ x 8′ David Pond Planer.
26″ x 26″ x 7′ Wheeler.
42″ Bickford radial drill press.
36″ Gould & Eberhardt upright drill with tapping attachment.

If interested wire or write for full particulars.
We solicit an inspection of any of the above.
Large stock of new and second-hand lathes, drills, shapers, planers and all lines of machinery.

FRANK TOOMEY, Inc.
127-131 N. 3rd St., PHILA., PA.

Boring Mills—BULLARD

30″, Swivel Turret, comb chuck, "Near New"
42″ double head with turret, comb. chuck, "Good"
DRILL—28″ **Prentice,** geared feeds, equipped for tapping, "Near New"
GRINDER—No. 2 **Brown & Sharpe,** universal, capacity 12″ x 30″, "Near New"
FLAT TURRET—2″ x 24″ **Jones & Lamson,** with tools, "Good"
TURRET LATHE Semi-auto **Potter & Johnston,** 2″ hole, power cross feed, "Near New"
TURRET LATHE—26″ x 10′ **Bullard** triple geared, 3⅜″ hole, screw cutting, hex. turret. Will face 21″ diam, "Good"
LATHE—18″ x 8′ **Lodge & Shipley,** rapid reduction type, "Good"
LATHE—32″ x 12′ **Fitchburg,** modern style, "Good".
GEAR CUTTER—24″ **Becker-Brainard,** automatic, cuts spur and bevels, "Near New"
PLANER—28″ x 28″ x 10′ **Gray,** double head, "Near New"
SLOTTER—12″ **Sellers,** 30″ table with all feeds. "Good". *Full information upon request*

McCABE MACHINE CO. P. A. McCabe, Pres., 95 Liberty Street, NEW YORK.

New, "Near New" and Good Second-hand Machinery

BRISTOL COUNTERS

The Counters that Count—and Count Right.

Simple, few parts, no spring. Adaptable for any machine, cannot be tampered with, and provide an infallible record of the day's output, which is automatically registered. Strong, convenient and compact. Ask for Catalogue No. 27.

THE C. J. ROOT COMPANY, Bristol, Conn.

The Oil and Waste Saving Machine Co., 1307 Real Estate Trust Building

PHILADELPHIA, PA.

Will save you 10 to 50% in your oil cost and 50 to 90% in your cotton wiping waste or machinery wiping material cost.

Second-Hand Machinery

Located at Boston, Chicago and New York

LATHES

12"x6' Champion Comp. Rest.
13"x6' Pratt & Whitney Rise & Fall Rest.
14"x6' F. B. Miles Compound Rest.
16"x6' Speed Lathe.
14"x5' American Square Arbor—$50.
15"x6' Shepard Rise & Fall Rest.
16"x6' Flather Comp. Rest.
16"x8' Reed Plain Rest.
18"x6' Blaisdell Rise & Fall Rest.
19"x6' D. W. Pond Turret Tool Post.
21"x6' Bridgeport Turret Boring.
21"—48" Harrington Gap. Boring and Chucking.
21"x8' Star Turret on Carriage.
21"x 8' P. & W. Plain Swivel Rest.
22"x10' F. B. Miles Compound Rest.
22"x16' Fitchburg Shafting.
24"x14' Harrington Plain Rest.
30"x10' Bement & Dougherty Compound Rest.
32"x10' D. W. Pond Comp. Rest.

TURRET MACHINERY

1/4" No. 00 Garvin Wire Feed.
3/8" No. 0 P. & W. Wire Feed.
1/2" No. 1 P. & W. Wire Feed.
1/2" No. 1 Garvin Wire Feed—$125.
5/8" No. 2 Garvin Wire Feed.
5/8" No. 1 Costello Wire Feed—$165.
2 15/16" No. 3 Niles Screw Mach.
24" Conradson Semi-Auto.
28" Milwaukee.
28" Size J. Gisholt.
1/4" No. 0 Hartford Auto.
3/8"x1" National Acme 4 Spdle. Auto—$200.
1/4" No. 00 Hartford P. & W. Auto.—$275.
5/16" No. 0 Hartford P. & W. 2 Spdle. Auto—$250.
1/2" No. 1 Hartford P. & W. 2 Spdle. Auto.
1/2" No. 1 Spencer Single Turret Auto—$150.
21/32"x1 1/2" No. 2 Brown & Sharpe Auto—$350.
No. 1 Almond Turret Head (new).

PLANERS AND SHAPERS

10" F. B. Miles Crank.
12" W. B. Bement Crank.
15" Hendey Friction.
18" B. & D. Crank.
14"x40" F. B. Miles Trav. Hd. Crank.
18" Cincinnati Dble. Hd. Traverse.
17"x17"x4' Whitcomb.
20"x20"x4' Ames.
42"x42"x20' F. B. Miles, 3 Heads.
48"x48"x20' Sellers, 3 Heads.
26"x26"x6' Pond.
26"x23"x16' Ferris & Miles, 2 Heads.
30"x30"x24' Sellers, 2 Heads.
48"x48"x16' Belmar Eames.
32"x32"x14' Niles.
32"x32"x12' Pond, 2 Heads.
32"x32"x14' Pond, 2 Heads.
36"x36"x20' Pond, 4 Heads.
40"x40"x26' Pond, 4 Heads.
86"x86"x30' Pond, 4 Heads.
86"x86"x35' Pond, 4 Heads.
78"x72"x24' Bement & Son, 4 Heads.

DRILLS

No. 4 Quint Rev. Tapp. Attach.
9" No. 1 P. & W. Bench.
13" No. 1 Sens. Dric. 110 v. d. c. motor.
18" Niles Stat. Head.
24" Niles Slid. Head.
24" Bement Stationary Head.
28" Pond Slid. Head.
30" Putnam Sliding Head.
30" Gould & Eberhardt Slid. Hd.
36" Gould & Eberhardt Slid. Hd.
48" Niles Sliding Head.
Prentiss Port. Univ. Rad. Cap. 2".
2 1/2' Hilles & Jones Semi-Rad.
3' Gair Plain Radial—$200.
4' 6" Barr Plain Radial—$200.
5' 6" Niles No. 1 1/2 Semi-Univ.
6' 10" Niles No. 2 Semi-Univ.
6' 10" Niles No. 2 Full Univ.
7' 6" Niles No. 5 Full Univ.
10" 2 Spindle Slate Sens.
2 Spindle Sigourney Sens.
12" 2 Spindle Foote Burt Sens.
10" 3 Spindle Slate Sens.
3 Spindle Sigourney Sens.
14" 4 Spindle D. P. M.—$75.
17" 4 Spindle Jones & Lamson Gang—$75.
12" 4 Spindle Garvin Gang.
14" 4 Spindle No .3 Garvin Gang.
14" 6 Spindle No. 3 Garvin Gang.
15" 6 Spindle Foote Burt Sens.
6 Spindle Special Langelier.
No. 10 10 Spindle P. & W. Cap. 1 15/16" 220 v. d. c. motor.

MILLING MACHINES

No. 1 LeBlond Vert. Mill. Attach.
No. 4½ Beck. & Brainerd Pl. 24"x7"x16".
No. 2 Garvin Plain 31½"x5"x16".
No. 2 B. & S. Univ. 20"x10"x16".
No. 4 B. & S. Univ. 40"x7"x2".
Garvin Sing. Spdle. Profiler Table, 21"x24"—$250.
72" Niles Spur Gear Cutter.
84" Niles Spur Gear Cutter.
½" Garvin Hor. Screw Slotter—$40.

BORING MILLS

No. 2 36" B. & S. Vert. Turret.
Nicholson & Waterman Boring Head 3" Spindle—$100.
37" Bullard Vert. 2 Heads.
Bement & Son Horizontal Spdle. 2 7/8" Spdle.
Kelly Horizontal Spindle, 2" Spdle.
Bement-Miles Horizontal, 2 7/8" Spdle.
Sterns 96" Spec. Cyl. Borer.

GRINDERS

No. 1 Bath Universal.
8"x2" Pedick Dbl. Wet Tool—$20.
14"x2" Gould & Eberhardt Water Tool—$25.
24"x3' Pedick Wet Tool—$75.
20"x1½" Ransom Water Tool.
3" Sellers Drill Grinder.
Gisholt Tool Grinder.
Springfield Style B Face & Variety.
No. 0 Northampton Polishing Jack.

RAILROAD MACHINERY

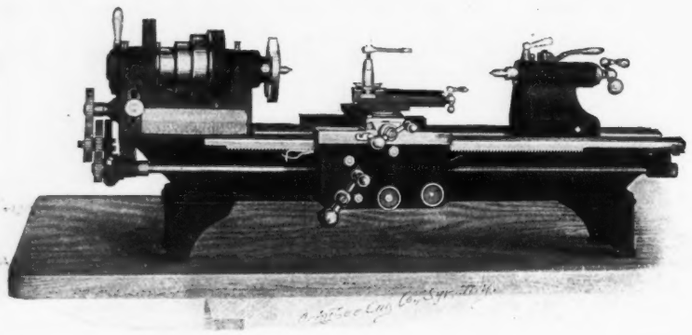
Lathe Axle Bement Single—$150.
Lathe Axle No. 2 Bement Dble.
Lathe Axle No. 2 Niles Dble.
Lathe Axle No. 3 Putnam Double.
Lathe Car Wheel 46" Bement Dble.

MISCELLANEOUS

Comb. Pcn. & Sh. 3/8" Cap.—Power—$25.
No. 0 Stiles Pattern Punch Press.
3" Power Arbor Press—$50.
6" Crank Slotter, Bement.
Cotter & Keyseat Drill Mach., Bement.
No. 1 Garvin Horiz. Tapp. Machine.
2½" Betts Cut-off Machine—$75.
3½" H. & R. Cut-off Machine—$50.
4½" Star Cut-off Machine.
Shuster Spiral Spring Winding Mach.
Hartford Rubber Small Vulcanizer.
16" B. & O. Cold Saw, Cap. 5" rd.
200 H.P. McIntosh-Seymour Hor. Tand. Compound.
350 lb. Single Power Hammer.
16"x3½" Planer Vise—$25.
10"x2" Planer Vise Swiv. Base—$30.
13"x28" Iron Forge on legs—$5.

NILES-BEMENT-POND CO., 111 Broadway, New York

Located at Boston, Chicago and New York



9 in. "Star" Bench Lathe

For tool, model and scientific instrument makers, laboratory and experimental work, in short, for profitable use in all lines of fine, accurate manufacturing and precision service.

A very complete lathe, has a large line of conventional attachments and covers a wide range of work.

Send for Catalog B.

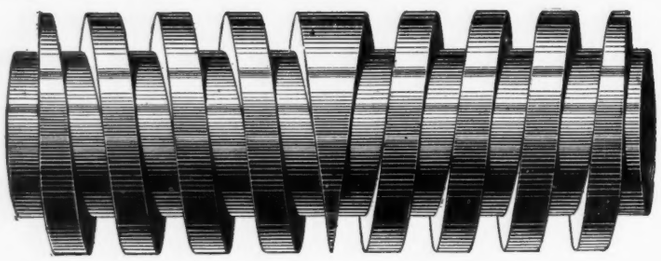
The Seneca Falls Mfg. Co.

330 Water St., Seneca Falls, N. Y.

173-A

On Difficult Thread Work

either internal or external, the Automatic Threading Lathe shows results in accuracy and finish which satisfy the most exacting workman. You can triple the output of the ordinary engine lathe with this machine and better the quality of work produced. Right or left hand threads, coarse or fine, it's all the same to the Automatic. Try it.



See Catalogue

AUTOMATIC MACHINE CO., BRIDGEPORT, CONNECTICUT

AGENTS—Alfred H. Schutte, Schuchardt & Schutte, C. W. Burton, Griffiths & Co., of London, England. Marshall & Huschart Machinery Co., Chicago, Ill., and Motch & Merryweather Machinery Co., of Cleveland, O. Vandyck Churchill Co., Philadelphia, Pa.

Hardness Testing

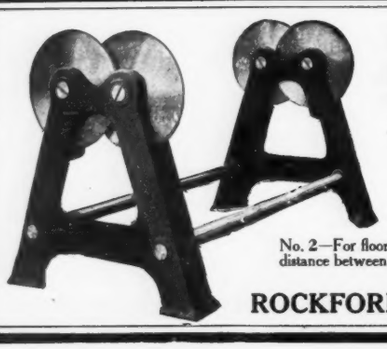
You are now obliged to do, to keep abreast with the times.

The Scleroscope

is what they all use. Order your metals to hardness specifications and save money. Also get your tools right. For further information and free book write.

SHORE INSTRUMENT & MFG. COMPANY

555-557 West 22nd Street, NEW YORK



TWENTIETH CENTURY BALANCING TOOL

Always Level - No matter where or how you place it. Always ready.

A practical tool for balancing pulleys, cones, polishing wheels, etc., requires no leveling or adjusting. Two sizes—No. 1, for bench use, will balance 22" pulley. Greatest distance between standards 20". Net price $15.00.

No. 2—For floor use balances work up to 46" diameter. Greatest distance between standards 30". Net price $18.00.

MANUFACTURED BY

ROCKFORD TOOL CO., Rockford, Ill.

Professional

PATENTS SECURED TO PROTECT INVENTIONS

ROYAL E. BURNHAM

PATENT ATTORNEY

837 Bond Bldg. Washington, D. C.

Send for free booklets on Patents and Trade-Marks

TRADE-MARKS Registered in U. S. Patent Office

HOWSON & HOWSON

Attorneys at Law, Solicitors of Patents

32 South Broad Street, Philadelphia, Pa.

55 Liberty St., N. Y. 918 F St., Washington, D. C.

PATENTS

MACDONALD & MACDONALD

Counselors at Law and Solicitors of Patents

Hudson Terminal Bldg., 50 Church St., New York

PATENTS

C. L. PARKER

Late Examiner, U. S. Patent Office

Attorney-at-Law and Solicitor of Patents

Patents secured promptly and with special regard to the full legal protection of the invention. Handbook for inventors sent upon request.

200 McGill Building Washington, D. C.

PATENTS Trade-marks, copyrights, designs. Correspondence invited from parties desiring the personal services of a conservative attorney. Send for booklet, special offers, etc. Manufacturers represented. Advice costs nothing.

R. B. OWEN, Warder Bldg., Washington, D. C.

SYDNEY I. PRESCOTT

Invention Developer, Machine Designer, Solicitor of Patents

111 Fifth Avenue, New York, N. Y.

PROTECT YOUR IDEAS

Under our plan inventions may be gotten before the Patent Office at the low cost of $20. Consultation free; send for handbook.

MILO B. STEVENS & CO., Attorneys

ESTABLISHED 1864

792—14th St., Washington, D.C. 356 Monadnock Blk., Chicago

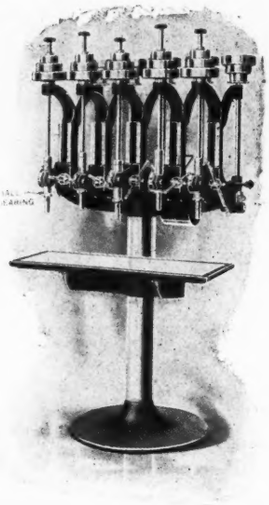
Guaranteed and recommended by the Bankers Register. Highest rating by Martindale's American Law Directory.

GEO. P. WHITTLESEY

Patent Lawyer and Solicitor of Patents

McGill Building, 908-914 G Street

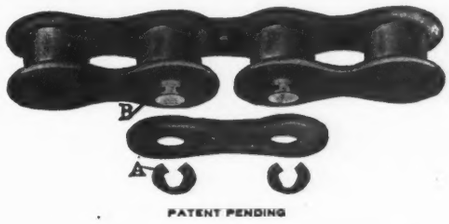
Washington, D. C.



SENSITIVE DRILLS

With or without Automatic Feed, Automatic Stop and Automatic Quick Return of the Spindle

FRANCIS REED COMPANY
43 Hammond Street, Worcester, Mass.



PATENT PENDING

Baldwin Improved Detachable Chains

both block and roller are especially convenient for drive chains for machinery.

The length can be easily altered. The clips are not a spring, will not break nor come off, and are as easily removed as a cotter pin.

SPROCKETS

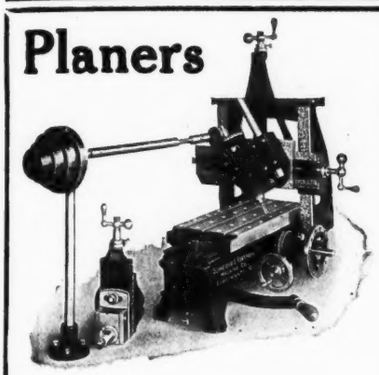
We are fully equipped to do sprocket work accurately and at satisfactory prices.

BALDWIN CHAINS AND SPROCKETS

Baldwin Chain & Mfg. Co.
200 Chandler St., WORCESTER, MASS.

AGENTS—H. V. Greenwood, 166 Lake St., Chicago. C. J. Iven, Rochester, N. Y. M. A. Bryte, 718 Mission St., San Francisco, Cal.

Planers



Our 10 inch Bench Planer is just what you need for die making, jig, model, experimental or tool room work. Milling Attachment, as shown, can be added at any time. We have larger power planers under construction. Highest quality of workmanship throughout. *Write us for particulars.*

The Schneider & Goosmann Machine Co.
1929 Race Street, CINCINNATI, OHIO, U. S. A.

ROTHMOTORS
ROTHMOTORS
ROTHMOTORS
ROTHMOTORS
ROTHMOTORS
ROTHMOTORS
ROTHMOTORS

ROTHMOTORS are properly designed, carefully manufactured, and give universal satisfaction.

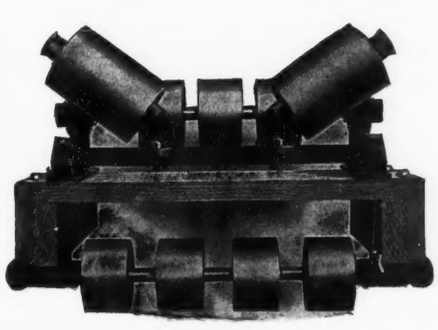
ROTH BROS. & CO. 1394 W. ADAMS STREET CHICAGO, ILL.

New York Office: 136 Liberty Street

Gears

CUT GEARS OF ALL KINDS
Spur, Bevel, Spiral
Worms and Worm Wheels, Sprockets

New England Gear Works 100 Purchase St. BOSTON, MASS.



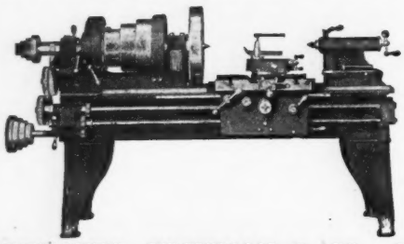
Improved Belt Conveyers

We manufacture Improved Belt Conveyers of several styles, troughing the belt or running it flat, as conditions may warrant. These conveyers are economical of power, simple in design, capable of running 24 hours per day, and require little time or attention from any one. There's no harm in writing us. *Send for Catalogue No. 34.*

H. W. Caldwell & Son Co. Western Ave. 17th-18th St. Chicago

NEW YORK: Fulton Bldg., Hudson Terminal, 50 Church St.
BOSTON: Oliver Bldg., 141 Milk St.

STANDARD ENGINE LATHES



5 STEP STANDARD

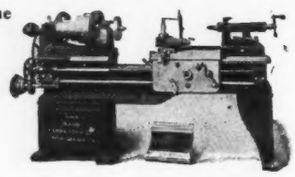
3 STEP DOUBLE BACK-GEARED

GREAVES, KLUSMAN & CO., CINCINNATI, OHIO, U. S. A.

RAHN-CARPENTER
Engine, Gap and Turret
LATHES

16-inch Lathe

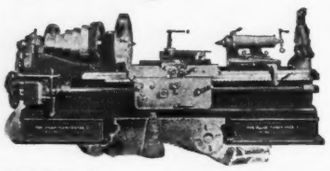
Send for our latest Catalog.



Gap Lathe

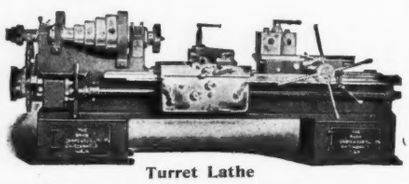
handle all the steps in lathe work. On regular or special, light or heavy work within the full range of a 16″ to 32″ swing, the Rahn-Carpenter line is supreme.

Our lathes are built for service. We define this term as convenience, power, economy, adaptability — complete satisfaction for the buyer.



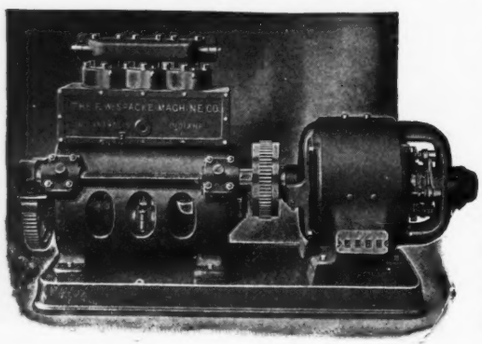
32-inch Lathe

The Rahn-Carpenter Company
CINCINNATI, OHIO



Turret Lathe

An Air Compressor for the machine shop or automobile garage, that will meet a wide range of requirements with efficiency and economy.



The Spacke Air Compressors

are small capacity machines, single or three cylinder type. Simple in design and built to stand hard and continuous usage.

If your needs demand compressed air in volume from 1 to 100 cubic feet per minute, these machines cannot be equalled.

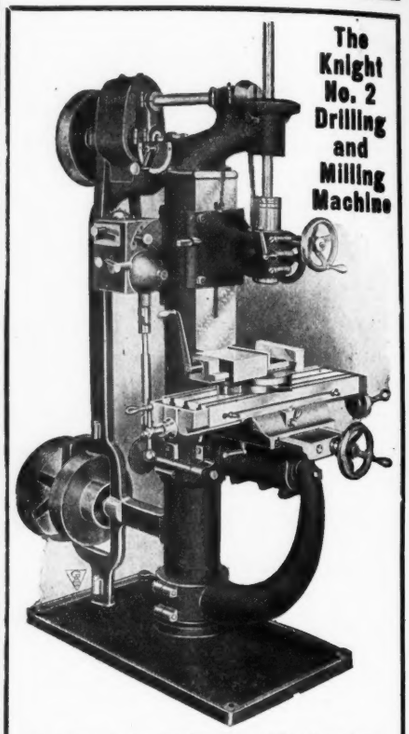
Various Sizes. Unexcelled Construction. Ask for Bulletins.

The F. W. Spacke Machine Co.
Indianapolis, Ind.

Automobile Transmission Gears **Automobile Motor Gears**

Special department for this division of our business. Estimates furnished.

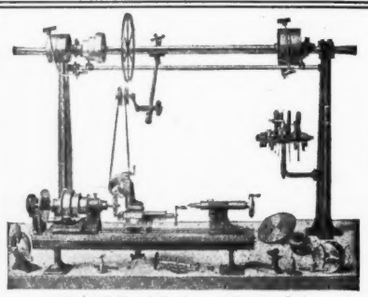
The Knight No. 2 Drilling and Milling Machine



Has many time saving features and handles a large range of work. All changes of feed and speeds are easily and quickly made. Is capable of handling a large variety of manufacturing work.

Write for further information.

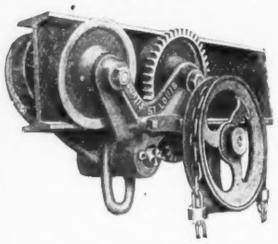
W. B. KNIGHT MACHINERY CO.
2019-25 Lucas Ave. ST. LOUIS, MO.



7" x 32" Bench Lathe and Countershaft.

The Elgin Tool Works, Elgin, Ill., U.S.A.

ADJUSTABLE SELF-EQUALIZING ROLLER BEARING TROLLEYS



Safe and Easy to Operate.

With self-equalizing side frames of steel. Wheels have machined treads, run at right angles to flanges of beam and are fitted with Hyatt flexible roller bearings. Adjustable for different size beams. Capacities up to 20,000 pounds.

Curtis Mfg. Co., 1568 Kienlen Ave. ST. LOUIS, MO.

HOISTS, New Patent Whip Patent Friction Pulleys
NONE BETTER MANUFACTURED BY
VOLNEY W. MASON & CO., PROVIDENCE, R. I., U. S. A.

We Predict

that all progressive manufacturers producing

Spur, Worm and Spiral Gears

will eventually be compelled to use

The Hobbing Process

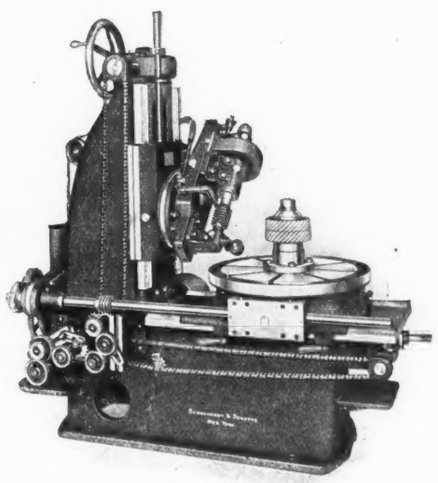
Gears produced therewith cost less to make, are theoretically correct, and, what is most important,

Run Absolutely Without Noise

This means doing away with all objections existing against gear drive and—transmission, even when used at a very high rate of speed.

Manufacturers of machinery of all descriptions, automobiles, elevators, gear cutting shops, etc., cannot afford to be without our

Original S. & S. Automatic Gear Hobbing Machines



For all classes and dimensions of work.

They will improve and perfect your own Product.

Our new 52-page Catalog for the asking.

Schuchardt & Schutte
90 West Street, NEW YORK

NEWARK

MACHINES FOR

Smooth Running Gears

MADE IN ALL SIZES.

FOR ALL CLASSES OF WORK.

Our No. 3 36" Spur Gear Cutting Machine.

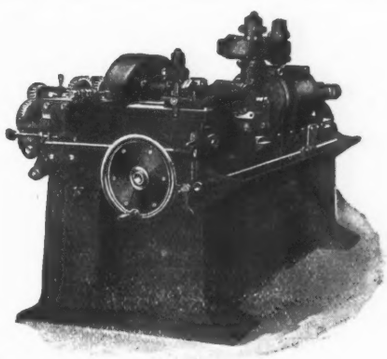
WRITE FOR CATALOG

Newark Gear Cutting Machine Co.

GEAR SPECIALISTS

HENRY E. EBERHARDT, Pres.
HENRY J. EBERHARDT, Sec.
FRANK E. EBERHARDT, Treas.

66 Union St., NEWARK, N. J., U. S. A.



A Manufacturing Tool

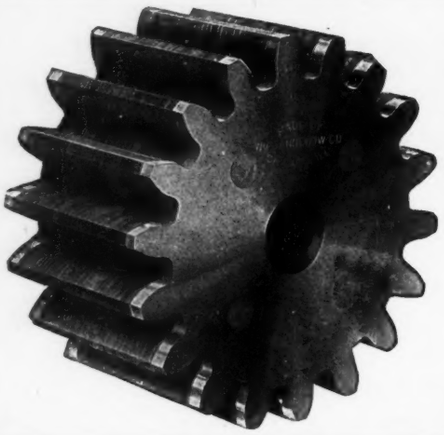
For Cutting

SPUR GEARS
WORM GEARS
WORMS
SPIRAL GEARS

Rapid--Rigid--Accurate

SEND FOR CATALOG

THE LEES-BRADNER COMPANY
CLEVELAND, OHIO, U. S. A.



When the speed is high and the strain great

GANSCHOW RAWHIDE PINIONS

get in their best work. They are made for hard service, have the strength of the all metal gear with greater durability, run without noise, mesh perfectly with other gears and are adapted for machinery of all kinds.

Get a few pointers on our Rawhide Pinions—or let us estimate on your Cut and Planed Gears also—Prompt delivery.

WILLIAM GANSCHOW COMPANY
Washington Boulevard and Morgan Street, Chicago, Ill.

Grant Gear Works

6 Portland St., Boston, Mass.

Gear Wheels and Gear Cutting

of every size and kind on hand and to order. Facilities complete.

Grant's Treatise on Gears
One dollar—worth ten.

Grant's Gear Book
Full information. Free.

Specify Quride for your Gears

The chemical treatment to which the hide has been subjected greatly increases the tensile strength, and also renders it insoluble and non-absorbent. Quride Gears are not only noiseless, but outwear rawhide or fibre, are much stronger, require only the lightest metal facing and give the best of service under all conditions.

QURIDE COMPANY
SYRACUSE, N. Y.

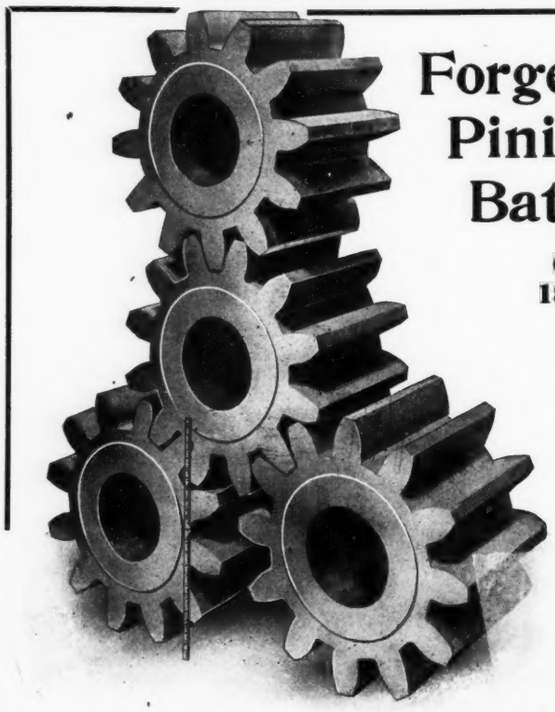
DISTRIBUTORS:
PETER A. FRASSE, New York, Buffalo, Philadelphia.
FRED. A. SCHMIDT, Washington, D. C.
VAN DORN & DUTTON, Cleveland, Ohio.
JNO. MILLEN & SON, Ltd., Montreal, Toronto, Vancouver.

QURIDE
Reg U S Pat Office

Gears and Gear Cutting

WE GUARANTEE SATISFACTION

RODNEY DAVIS, Philadelphia



Forged Steel Pinions for Battle Ships

6-INCH PITCH
18-INCH FACE

We are equipped for Gears and Gear Cutting of every description. Send us your inquiries.

THE EARLE GEAR AND MACHINE CO.
Wayne Junction,
Philadelphia,
Pa., U. S. A.

CULLMAN SPROCKETS

COMPLETE DRIVE FOR BLOCK & ROLLER CHAINS

BALDWIN DIAMOND & WHITNEY CHAINS ON HAND

IN STOCK OR TO ORDER

CATALOGUE FREE

CULLMAN WHEEL CO.
1019 GREENWOOD TERRACE - CHICAGO

BEVEL GEARS Cut Theoretically Correct

Facilities for cutting Spur, Worm, Spiral and Internal Gear Wheels.

Bevel Gear Generators and Special Machines

THE BILGRAM MACHINE WORKS, 1231 SPRING GARDEN ST. PHILADELPHIA, PA.

When You Need A Gear In A Hurry!

Send your orders to the Philadelphia GEAR Works—specialists in Rush Orders.

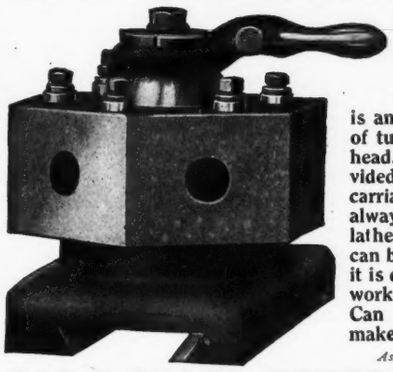
GEARS of any kind—spur, bevel, worm or intermittent—of any diameter, pitch or material.

Our free catalogue will help you to order—send for it.

Grant's "Treatise on GEARS"
A practical book of information and reference—Price $1.00.

PHILADELPHIA **GEAR** WORKS, INC.
1120 Vine Street, Geo. B. Grant, Pres. Philadelphia, Pa.

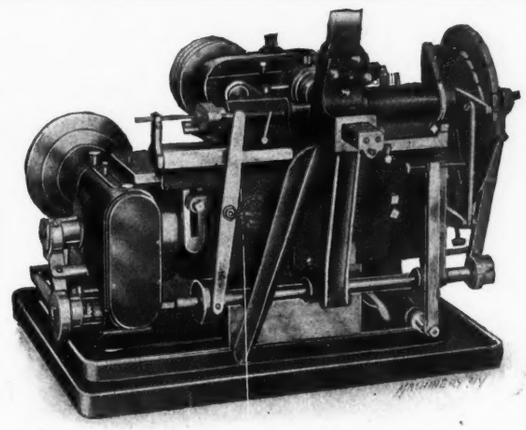
Get a Turret Lathe's Advantages



by using our Carriage Turrets on your engine lathe. The style "O" turret shown here is an extra heavy type of turret with hexagon head. A taper pin is provided for locking to the carriage, in a position always in line with the lathe spindle. This pin can be withdrawn when it is desired to face up work with the turret. Can be used on any make of lathe.

Ask for special booklet.

FAY & SCOTT, DEXTER, MAINE



15 to 20 Per Cent. Increase in Production.

Recent improvements in the Magazine Feed attachment incorporated in the Waltham Automatic Pinion Cutting Machine has so far increased the output of the machine that its value as a producer is almost doubled.

It is entirely automatic in operation, not liable to get out of order or adjustment, and is designed for the making of the small gears and pinions used in clocks, typewriters, recording instruments, etc.

We shall be glad to forward full scription of this high grade tool.

WALTHAM MACHINE WORKS
NEWTON STREET, WALTHAM, MASS.
Makers of Precision Bench Lathes and Machinery.

AUTOMOBILE GEARS

The building of automobiles is a big factor in the manufacturing world today. The making of Gears for these high speed, high grade, heavy service vehicles is a business in itself. We **specialize** on

AUTOMOBILE DIFFERENTIAL GEARS

1910 Catalogue and working estimate at your service.

BOSTON GEAR WORKS
NORFOLK DOWNS
MASS.

PORTABLE—CLEANLY—SAFE

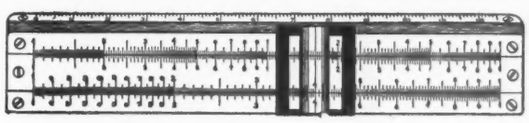
Unlike the ordinary tanks for keeping and distributing oil, the

DELPHOS FACTORY DISPENSER

never overflows, leaks or spills the oil on clothing, floor or hands.
It is the most practical method of storing oil, is adapted for any style hand oiler and works easily and quickly.
Every factory, mill or shop can afford a Delphos.

Write for prices.

Delphos Manufacturing Co., Delphos, O.



"MIDGET" SLIDE RULE

THE GIANT IN ACCURACY

Has the accuracy of a ten inch "Precision" Slide Rule, its ultimate subdivisions being as fine and as easily read through the powerful magnifying glass, and with the same percentage of accuracy.

Never varies. Convenient, compact, and easily portable.
Send for circular No. 19.

KOLESCH & COMPANY
138 Fulton Street - - New York City

GEARS

We cut Gears of every description, and in addition to our general line are large manufacturers of Hardened Steel Gears, with facilities to handle big orders promptly. The accuracy, durability and finish of Foote Bros. Gears particularly adapts them to the Automobile trade.

Price list and full particulars on request.

FOOTE BROS. GEAR & MACHINE CO.
Chicago, Ill., U.S.A.

Gears and Gear Cutting

Spur, Bevel, Mitre, Worm and Spiral Gears—

"MECHANICALLY CORRECT"

We have special facilities for "break-down" jobs and can handle orders of all kinds with dispatch. Let us figure on your work.

The Van Dorn & Dutton Company

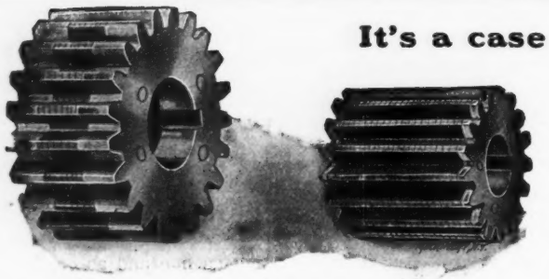
Cleveland, Ohio, U. S. A.

Three Qualities of "Nuttall" Cut or Planed Gears

Quality of material
Quality of workmanship
Quality of wear

Nuttall-Pittsburg

When in a hurry, wire us.



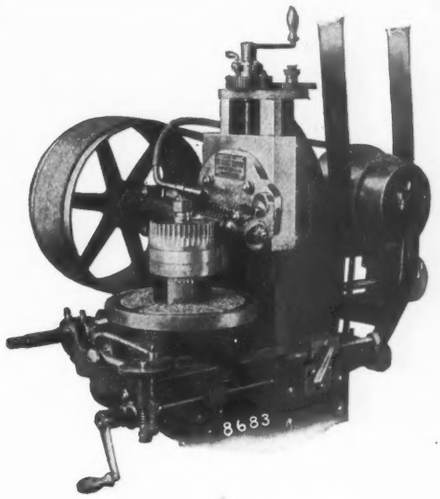
It's a case of "hush money" when you buy

PEERLESS RAWHIDE PINIONS

Peerless Rawhide Gears put a quietus on the shrieking gears that make most shops a bedlam, mesh perfectly with metal gears and insure a silent, smooth and satisfactory drive. They are power savers, durable and adapted for light or heavy service. Gears and Gear Cutting of all descriptions. *Send for "Blue Book on Gearing."*

The Horsburgh & Scott Co., Cleveland, O., U. S. A.

ALL TEETH AT ONE CUT
ON THE
FARWELL GEAR HOBBER



Our hob operates upon more teeth at a time than any other type of cutter, and cuts continuously from start to finish of an arbor full of blanks. Correct teeth and true pitch circles are generated, and the output so far exceeds all competition that you can not afford to cut spur gears on any other type of machine, or let your work to any concern not using FARWELL GEAR HOBBERS.

Get our Circular No. 802-M and send blue prints or sample blanks, so we can quote on the work or give output of machine.

THE ADAMS COMPANY, 835 White St., Dubuque, Iowa, U.S.A.

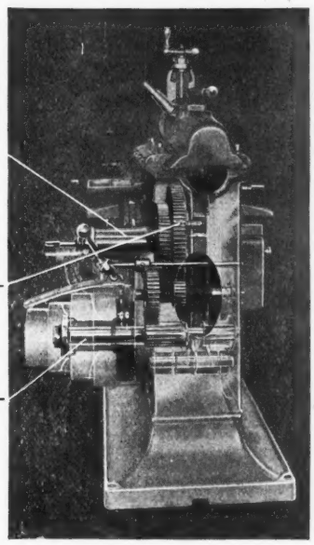
FOREIGN AGENTS: DeFries & Co., Dusseldorf, Germany. J. Lambercier & Co., Geneva, Switzerland. The Moscow Machine Tool & Engine Co., Moscow, Russia. V. Lowener, Copenhagen, Denmark. Glaenzer, Perreaud & Thomine, Paris, France. Aktiebolaget V. Lowener, Stockholm, Sweden. Ducas & Co., Vienna, Austria. Ducas & Co., Budapest, Hungary.

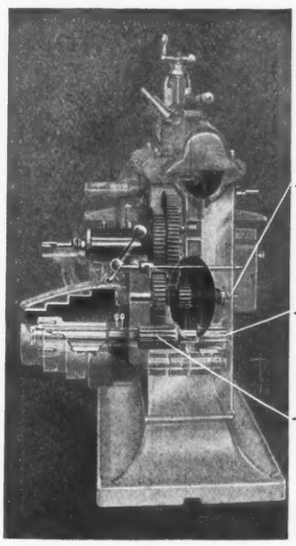
G. & E. SHAPERS HAVE A DOUBLE TRAIN GEAR DRIVE

Main hub bearing cast in one piece with the frame.

Note double bull gear.

Cone runs on patented bearing. Belt strain does not come on cone shaft.





This shaft stationary, hardened and ground: ideal bearing surfaces and exceptionally good lubrication.

The only revolving shaft.

Steel pinion.

BACK GEARED SINGLE GEARED

At 100 strokes per minute; fastest running gear in train runs about 30% slower than other constructions.

GOULD & EBERHARDT

"HIGH DUTY" SHAPERS
AUTOMATIC GEAR AND RACK CUTTING MACHINERY

ESTABLISHED 1833 NEWARK, N.J. U.S.A.

WE CUT ACCURATE METAL GEARS.

GEAR CUTTING is our specialty and this plant is second to none in facilities. No order is too large, too small or too difficult. Our decidedly modern equipment permits us to get out blanks and cut any kind of teeth at reasonable prices. Let us quote on your next requirements.

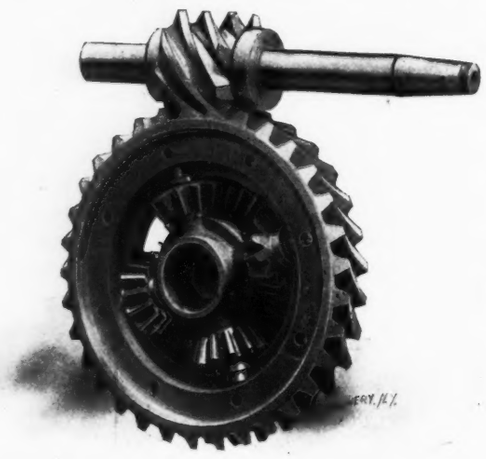
THE NEW PROCESS RAW HIDE CO.

SYRACUSE N.Y.

A. E. MICHEL, ADV. N.Y.

MORSE, WILLIAMS & CO.

ENGINEERS



announce that their business will hereafter be conducted by the

OTIS ELEVATOR COMPANY

HINDLEY WORM GEAR DEPARTMENT

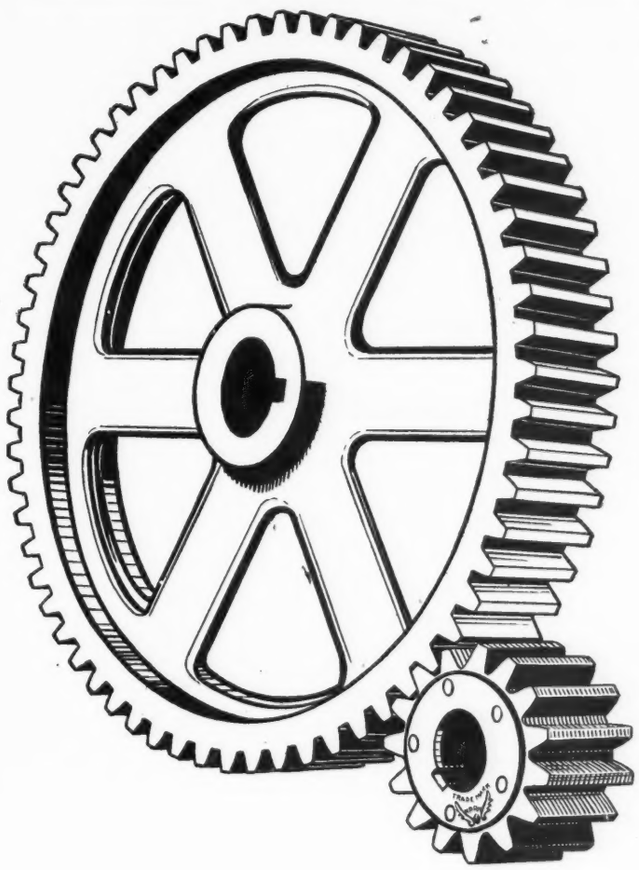
under the same personal management as heretofore, and with the same facilities for cutting all kinds of worm gears.

Inquiries are solicited on all gear problems without obligation.

Philadelphia, August, 1910.

If your office boy had bells on and whistled from morning till night, WOULDN'T YOU fire him for the sake of the work you have to do ?

The work your men have to do in the shop gets the same kind of a setback from the everlasting ringing racket of metal to metal gearing. The ring and roar of metal gears clashing at high speed gets on your men's nerves just the same as Whistling Rufus gets on yours. By firing out the noisy metal pinions and replacing them with New Process Noiseless Pinions, you can invariably decrease the number of misunderstandings in your shop and keep the men in better humor. New Process Pinions on the high speed drives usually do away with about nine-tenths of the noise in a busy shop.



Our New Process of curing the rawhide has made possible the production of pinions that wear like iron and permit silent driving without the irregularities and lower efficiencies of belting.

New Process have long been the standard by which other silent pinions are judged. Try one on your worst drive, or at least send for our booklet.

NEW PROCESS IS TO ALL OTHER RAWHIDE AS STEEL IS TO IRON

The NEW PROCESS RAW HIDE Co.

N.P.R.H. REGISTERED

OFFICE & WORKS SYRACUSE, N.Y.

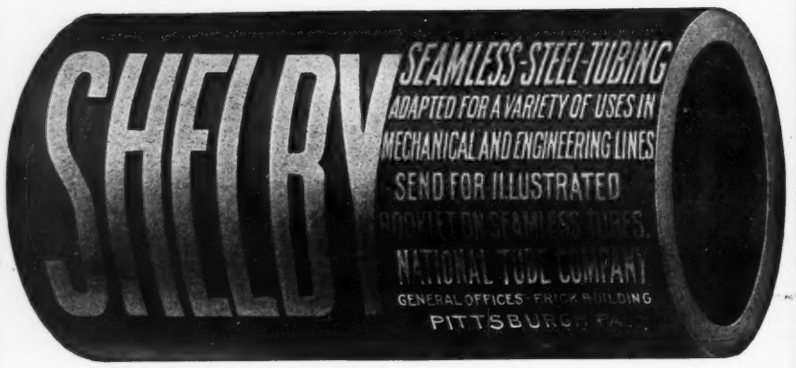
A.E. MICHEL ADV. N.Y.

COLD ROLLED STRIP STEEL

For Stamping and Drawing Purposes

EXTRA QUALITY

THE COLUMBIA STEEL CO. - ELYRIA, OHIO



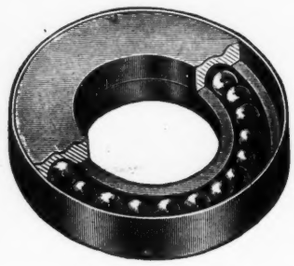
For the convenience of customers desiring immediate delivery, stocks of Shelby Seamless Steel Tubing are kept in the large cities; the location of stock nearest to any specific point will be advised on request.

DISTRICT SALES OFFICES:

Atlanta	Denver	New York	Pittsburg	San Francisco	Salt Lake City
Chicago	New Orleans	Philadelphia	Portland	St. Louis	Seattle

Export Representatives: U. S. Steel Products Export Co., New York City

THRUST BEARINGS



Bantam Anti-Friction Co.

Bantam, Conn.

"ULTRA CAPITAL"

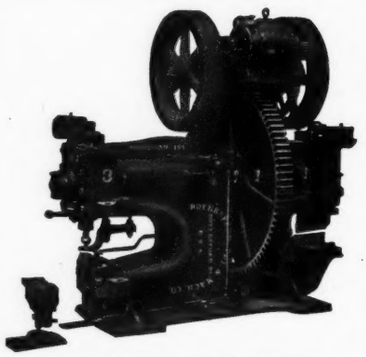
"Capital" "Capital"

New Water Hardening High Speed Steel.

Keen edge, lasts 5 to 8 times ordinary high speed.

DRAWN FLATS, key steel or tool steel from stock. Shapes of any kind to order. Largest assortment of bright material—strips, sheets, bars and wire.

Edgar T. Ward & Sons, 23-25 Purchase St., Boston, Mass.



ROYERSFORD PUNCH AND SHEARS

None better—few as good. Just the machine for Boiler Shops, Railroad Shops, Structural Works and Machine Shops. Machine is right; so is price.

New Catalogue just out.
Ask for one.

Royersford Foundry & Machine Co., Inc.
ROYERSFORD, PA.

MANGANESE BRONZE

CASTINGS OR INGOT—SEND FOR TEST BAR

LUMEN BEARING CO., BUFFALO

STEEL STAMPS

TRADE MARKS

SPEACIAL DESIGNS

High Grade Steel Letters and Figures

NOBLE & WESTBROOK.

'19 Asylum St., HARTFORD, CONN.

A. G. BUTLER

PATTERN LETTERS

For Iron and Brass Castings. Various styles and sizes. For Machines, Bridges, Tablets, etc.

Leather Fillet.

All sizes in stock.

Commonwealth Bldg., 284-286 Pearl St., New York

HAWKRIDGE BROTHERS COMPANY

303 Congress Street, BOSTON, MASS.

IN STOCK—in large quantities:

TOOL STEEL of all qualities in Bars, Sheets and Drill Rods.
HIGH SPEED STEEL.
HOT-ROLLED, O. H. & BESS.
SPRING STEEL in all qualities.
HIGH SPEED DRILL RODS.

FROM MILL:

KETOS Oil-Hardening STEEL.
CHROME-NICKEL STEEL.
CHROME-VANADIUM STEEL.
NICKEL STEEL.
SILICO-MANGANESE STEEL in Bars, Sheets, Strips and Special Shapes, Hot-Rolled and Cold-Rolled.

Our ALLOYS are made in the ELECTRIC FURNACE.

Our *products* are all of the *best*. *Write* for our *Stock-List*.

The Biggest Value—The Least Cost

SAWYER
Machinists' Fine Tools

Sold with the Sawyer Guarantee of Honest Quality and Dependable Accuracy.

Fifteen years the choice of discriminating machinists.

Special price reduction to shop agents.

Ask for our liberal proposition and new, illustrated catalogue.

Sawyer Tool Mfg. Company
FITCHBURG, MASS.

Top View

Get The Carpenter Quality

To buy Taps, Dies and other Screw Cutting Tools with this trademark C is to invest your money in the best tools that 39 years' experience, plus finest material and skilled workmanship, can produce.

Carpenter's Taps are celebrated for uniformity, are threaded true to size and give unqualified service.

No more complete line of Screw Cutting Tools is carried anywhere in the world, than in the Carpenter stock rooms.

Send us your inquiries.

REGISTERED TRADE-MARK

The J. M. Carpenter Tap & Die Co.
Pawtucket, R. I.

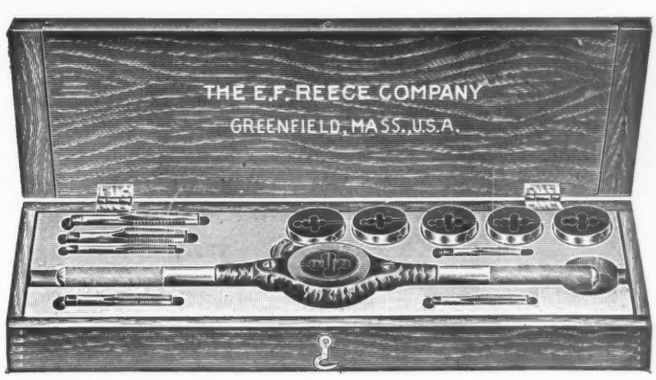
Reece Screw Plates

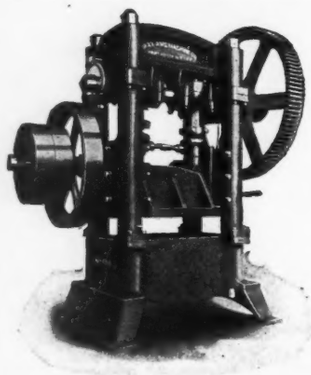
Absolutely correct in principle Reece Screw Plates give correct results. Fitted with our patent Adjustable Guides and Adjustable Dies, true, straight and perfect threads are obtained at one cut. Reece Dies do more work and better work than other dies, are more easily adjusted and stand harder usage. Threads cut with Reece Tools are fully equal to the product of the lathe or bolt cutter.

Ask for Catalogue No. 7 showing full line of Screw Cutting Tools.

E. F. REECE COMPANY
10 Wells St., GREENFIELD, MASS., U. S. A.

NEW YORK OFFICE: 101 Reade Street.





No. 1015 Double Pitman Press

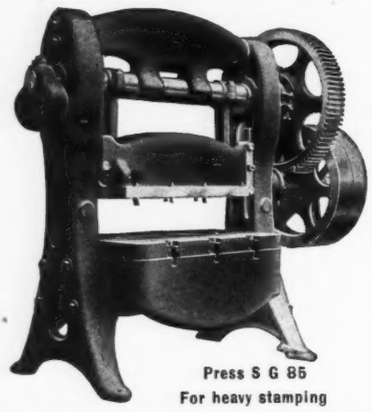
Weighs 20,000 lbs.

Another new one. Takes sheet 20 x 48 in. or 25 x 25 in. with distance between uprights 34 in. only. How does it do it? We'll tell you all about it.

Max Ams Machine Company
Mount Vernon, New York City

FERRACUTE PRESSES

FOR CUTTING AND FORMING SHEET AND BAR METALS.
HUNDREDS OF SIZES AND STYLES FOR EVERY KIND OF WORK.



Press S G 85
For heavy stamping

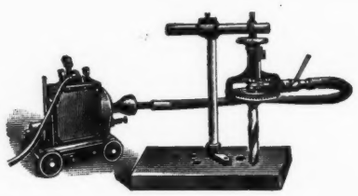
The press shown above represents the fifth size in a series of seven "Heavy" stamping presses designed for pressures up to 100 tons. A similar series, but from lighter patterns, is adapted for 50 tons pressure and two heavier series exert pressures of 200 to 500 tons respectively. Round, open, wide, narrow or drop beds. Photographs and full information mailed on receipt of sample or specification.

Ferracute Machine Co., Bridgeton, N. J.

EUROPEAN AGENTS: Chas. Churchill & Co., London; Fenwick Freres & Co., Paris; Wilh. Sonesson & Co., Copenhagen.

Convert a Waste into a Revenue by using a

Stow Flexible Shaft Outfit

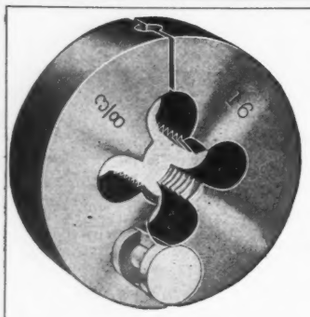


The many jobs that now take several machines, two or three operators and a lot of time can be made to bear a profit if finished with this outfit, which grinds, drills, bores, reams, etc.—simply change the tools.

There are probably several ways that flexible shafts can be applied to your work to bring running expenses down to a much lower level of economy, and produce more satisfactory results in less time than you may think possible.

We are ready to demonstrate this fact promptly and thoroughly at your earliest convenience. Drop us a line for the catalog of time-saving specialties.

Stow Flexible Shaft Company
26th and Callowhill Sts., PHILADELPHIA, PA.



YOU wouldn't use a forming cutter, a milling cutter or a lathe cutting tool, without first sharpening after hardening.

Why, then, put up with a dull screw cutting die when you can obtain one that has been sharpened after hardening?

A die that will outwear the ordinary kind many times and produce perfect threads at a single cut should interest you—
We make just that kind of a die and shall be glad to send particulars.

Remington Tool & Machine Co., Boston, Mass.

MACHINERY'S Shop Operation Sheets

∘ Specimen Shop Operation Sheet ∘

Showing size, style, binder holes, etc.

SHOP OPERATION SHEET No. 101

Franklin D. Jones MACHINERY, June, 1909

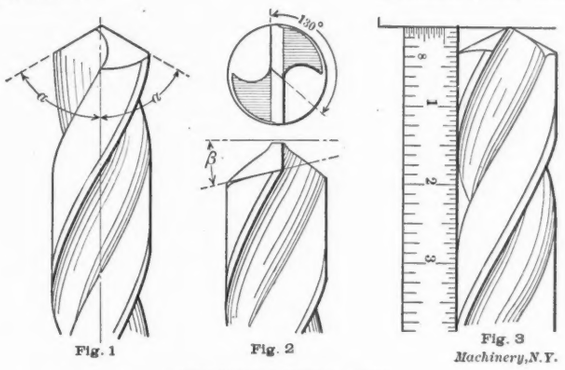


Fig. 1 Fig. 2 Fig. 3

Machinery,N.Y.

Grinding a Twist Drill

NOTE.—The cutting edges of a twist drill should, as with the flat drill, be equiangular, of the same length, and have the same clearance. When both the cutting edges of the drill are ground to the same angles α, one cutting edge supports or counteracts the tendency of the other to spring from the cut (providing the clearance is also correct), but when the angles α are different, one edge will do more work than the other, thus subjecting the drill to an unbalanced twisting or torsional strain.

1. Grind each cutting edge to an angle α of 59 degrees (see Fig. 1), using the face of a wet emery wheel, and proceeding the same as if a flat drill were being ground, as described in paragraph 2 of the preceding sheet. The end of the drill will then appear as shown in Fig. 2. The clearance angle will be approximately correct when the line joining the cutting edges is at an angle of 130 degrees as shown.

NOTE.—There is a difference of opinion as to the best angle α of the cutting edge. As this angle is decreased the pressure required to force the drill through the metal becomes less, but the length of each cutting edge is increased with the result that more power is required to turn the drill. An included angle of 118 degrees is thought by some to equalize the thrust and torsion to the best advantage, while others advocate much more acute angles.

2. Grind away the metal back of each cutting edge, indicated by the shaded portion (Fig. 2), by moving the outer end of the drill, which is fulcrumed on the tool-rest, up and down with the right hand. Continue grinding until a surface, which should be approximately conical in form, is blended into the flat part previously ground. The backing or clearance of the cutting edges should be of such a form and angle as to allow the drill to cut freely and without binding as it is fed into the metal.

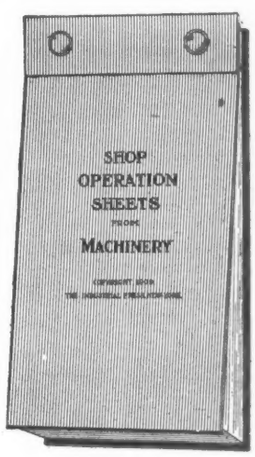
3. The clearance for each cutting edge may be tested by placing the drill point against a flat surface, and then slowly revolving it close to a scale held in the position shown in Fig. 3. If the clearances are not approximately alike, this will be shown by their relative positions to the graduation marks upon the scale, as the drill is turned.

The Shop Operations are laid out in note-book form, three operations on a sheet which measures about 9 x 13 inches. They are printed on tough manila paper and may be cut apart for filing in a binder, which is furnished at cost. Most of the Shop Operation Sheets have been issued monthly with MACHINERY, as supplements, and have been reprinted for general sale; but some have been and are published independently from time to time.

The Shop Operation Sheets contain the essentials for the apprentice as well as for the skilled worker who lacks the knowledge and experience of the all-around mechanic. Draftsmen can acquire a knowledge of a wide range of shop operations by studying these sheets, in which the instructions are so direct, simple and straightforward, that it is possible for any intelligent man to acquire a fundamental knowledge of all-around shop practice, and which only a comparatively few have an opportunity to secure except by actual experience in the works. Teachers of machine shop practice show their appreciation of the practical value of these Shop Operation Sheets by using them as instruction sheets in their classes, and supplying the students with them.

The Binder for MACHINERY'S Shop Operation Sheets will conveniently hold all the sheets that have been published, and all that will be published during the next two or three years.

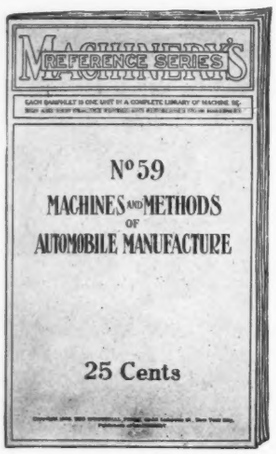
The complete set of Shop Operation Sheets now comprises 141 distinct operations laid down so you can go right ahead. The complete set, in binder $2.00.



In this number of MACHINERY, on the fourth page of this announcement we make a special offer worth considering.

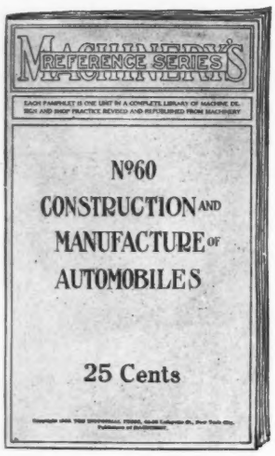
MACHINERY, The Industrial Press, 49-55 Lafayette St., New York City

The Automobile as the Machinist Sees it



No. 59—Machines and Methods of Automobile Manufacture

These two books on Automobile practice give you exactly the kind of information MACHINERY endeavors always to give to its readers. It is such information as practical men want and can instantly grasp. There is no discussion or introduction to waste time and effort. There is in No. 59, a simple, direct, straightforward description of Automobile Shop organization, equipment, machines, tools, etc.; an exceedingly interesting and informing chapter on the rapid assembly of Motor Cars and a concluding chapter on the treatment of gears for automobiles. A book packed with well-digested, definite information, and sold at 25 cents, which wouldn't pay for one of the photographs in it.



No. 60—Construction and Manufacture of Automobiles

No. 60 contains exactly what its title says it does. The engraving shown on page 5 is alone worth the price of the book. The purpose behind these books is carried effectively through them from cover to cover. It is educational in the practical sense. It is to bring to the reader the information he would work hard to secure if he were right there himself. The mechanical details are described and illustrated with great care by men thoroughly trained for such work and perfectly familiar with mechanical problems from actual experience in shop and drafting-room. The chapter on equalizing gears would serve very well as an advertisement for the whole Reference Series comprising 60 books. Price 25 cents and up to the minute.

A FEW GROUP HEADINGS

The 412 Receipts are Carefully Classified

Blue-print Writing Fluids.
Solutions for Preparing Blue-printing Paper.
Methods of Treating Blue- and Brown-prints.
Miscellaneous Drafting-room Receipts.
Cements for Metals.
Cements and Filling for Cast Iron.
Cements for Pipe Joints.
Cements for Attaching Cloth, Emery, etc., to Iron.
Cements for Leather.
Cements for Leather and Metals.
Cements for Attaching Glass and Marble to Metals.
Cements for Gluing Emery, Metals, etc., to Wood.
Cements for Miscellaneous Purposes.
Glues and their Preparation.
Etching Fluids, etc., etc.

412 Shop Receipts and Formulas

NEW AND ENLARGED EDITION

A Receipt may cost the man who works it out to a success anywhere from five to five hundred dollars. There are men working in manufacturing plants in whom the spirit of invention and enterprise is persistent and irrepressible, and takes no note of costs. It just works for results and they are willing instruments of its activity. Actually these men are one with the alchemists of old, ever boiling and testing and seeking—and all for the race. And having studied and labored, and endured a thousand disappointments, they make their discovery at last, or at least they make a good one they weren't looking for, and, like eager children, run with it all full of happiness to give all gladly to their kind. We don't know what sum might measure the cost of these 412 Receipts. Doubtless, there are items in the cost that money couldn't measure at all, any more than money can measure the depth of joy or disappointment. We have put the 412 together in a splendid book, sold at one dollar, and on the basis of ordinary book prices, worth at least two.

A Complete Working Library

The Reference Books were originated by MACHINERY, and announced for the first time on January 1, 1908. Their success was instantaneous. The plan comprehends an indefinite number of compact, inexpensive books, each covering one subject thoroughly in a practical manner, and sold singly, or in complete sets, as may be desired. The whole series comprises a complete working library of authentic mechanical literature for the Mechanical Engineer, the Master Mechanic, the Designer, the Machinist, the Toolmaker and the Apprentice.

The information contained in the books of this Reference Series is the very best that has been published on machine design, construction and operation during the past fourteen years, revised and brought up to date by MACHINERY'S editorial staff—men constantly in touch with the best sources of information, and with the latest developments in mechanical practice.

Each book measures 6 x 9 inches, standard size, and contains from 32 to 54 pages, depending upon the amount of space required to adequately cover its subject. They are first-class in every respect—printed from new type, with new and ample engravings, on the same high-grade paper that is used for MACHINERY, and have wide margins to allow for binding in sets, should this be desired.

The plan is very successful, as we predicted it would be, and we repeat what was said in the first announcement, that the Reference Series was not originated as a money-making proposition—but for other reasons; and in order to make these books available to the greatest possible number the price was fixed at 25 cents per copy.

Sixty books have been published to date and the titles are listed below. MACHINERY stands back of these books and recommends them to practical men on every level in the mechanical field. They are especially valuable to those men whose reading time is limited to essentials. These books appeal with special force to Draftsmen, Machinists, Toolmakers—to all the men working at drafting-boards, lathes, planers, milling machines, shapers and all the standard and special machines and tools—the useful and practical men whose opportunities and means for securing information outside of their specialty are limited.

The price is 25 cents per copy

MACHINERY, The Industrial Press, 49-55 Lafayette St., New York, U.S.A.

Great Britain, Messrs. WM. DAWSON & SONS, Ltd., London, E. C.

MACHINERY'S REFERENCE LIBRARY

Complete List of Titles

25 cents (one shilling) per copy

Please check your titles

1 Worm Gearing.
2 Drafting-Room Practice.
3 Drill Jigs.
4 Milling Fixtures.
5 First Principles of Theoretical Mechanics.
6 Punch and Die Work.
7 Lathe and Planer Tools.
8 Working Drawings and D. R. Kinks.
9 Designing and Cutting Cams.
10 Examples of Machine Shop Practice.
11 Bearings.
12 Mathematics of Machine Design.
13 Blanking Dies.
14 Details of Machine Tool Design.
15 Spur Gearing.
16 Machine Tool Drives.
17 Strength of Cylinders.
18 Shop Arithmetic for the Machinist.
19 Use of Formulas in Mechanics.
20 Spiral Gearing.
21 Measuring Tools.
22 Calculations of Elements of Machine Design.
23 Theory of Crane Design.
24 Examples of Calculating Designs.
25 Deep Hole Drilling.
26 Modern Punch and Die Construction.
27 Locomotive Design—1, Boiler and Cylinders.
28 Locomotive Design—2, Valve Motion.
29 Locomotive Design—3, Smokebox, Frames and Driving Machinery.
30 Locomotive Design—4, Springs, Trucks, Cab and Tender.
31 Screw Thread Tools and Gages.
32 Screw Thread Cutting.
33 Systems and Practice of the Drafting-Room.
34 Care and Repair of Dynamos and Motors.
35 Tables and Formulas for Shop and Drafting-Room.
36 Iron and Steel.
37 Bevel Gearing.
38 Grinding and Lapping.
39 Fans, Ventilation, and Heating.
40 Fly-Wheels.
41 Jigs and Fixtures—1, Principles of Design, etc.
42 Jigs and Fixtures—2, Open and Closed Drill Jigs.
43 Jigs and Fixtures—3, Principles of Boring Jig Design, etc.
44 Machine Blacksmithing.
45 Drop Forging.
46 Hardening and Tempering.
47 Electric Over-Head Cranes.
48 Files and Filing.
49 Girders for Electric Over-Head Cranes.
50 Principles and Practice of Assembling Machine Tools—Part I.
51 Principles and Practice of Assembling Machine Tools—Part II.
52 Advanced Shop Arithmetic for the Machinist.
53 Use of Logarithms and Logarithmic Tables.
54 Solution of Triangles—Part I.
55 Solution of Triangles—Part II.
56 Ball Bearings.
57 Metal Spinning.
58 Helical and Elliptic Springs.
59 Machines, Tools and Methods of Automobile Manufacture.
60 Construction and Manufacture of Automobiles.

The Shop Operation Sheets, Some Reference Books and a Subscription

AN AUGUST OFFER, GOOD UNTIL SEPTEMBER 10, 1910

OFFER A 4

412 Shop Receipts	$1.00
141 Shop Operation Sheets and Binder	2.00
24 Reference Books (Your selection. See titles.)	6.00
MACHINERY Subscription Your choice of Editions: Engineering Edition, 1 year or Shop Edition, 2 years OR Railway Edition, 1 year	2.00
	$11.00
Allowance until Sept. 10, 1910 on Shop Operation Sheets and Books	2.50
Net	$8.50

50 cents with order, $1.00 monthly for 8 months.

OFFER A 5

141 Shop Operation Sheets and Binder	$2.00
412 Shop Receipts	1.00
4 Reference Books (Your selection. See titles.)	1.00
MACHINERY Subscription Your choice of Editions: Engineering Edition, 1 year or Shop Edition, 2 years OR Railway Edition, 1 year	2.00
	$6.00
Allowance until Sept. 10, 1910	$1.50
Net	$4.50

50 cents with order, $1.00 monthly for 4 months.

Please don't ask us in October to fill one of these offers. They expire September 10, and MACHINERY'S Offers, as hundreds have learned, are never repeated. Material and conditions change constantly and an offer out today cancels all former offers and ends on the day specified.

But the right to return anything you buy from us if not satisfied always holds good whether specified or not. You can surely tell in 30 days. Just send in your order at once, with or without the first payment, and the order will be put right through. The first payment may be held back for 10 days if you like. We know the men in the mechanical field. Remember that these offers expire September 10, 1910. Messrs. Wm. Dawson & Sons, Ltd., London, E. C. will take care of friends in Great Britain, and no delay. They carry a stock. Figure the pound sterling at $4.86.

PLEASE CUT OUT ON THIS LINE

SPECIAL ORDER BLANK FOR OFFERS A 4 AND A 5

MACHINERY, The Industrial Press, Publishers,
49-55 Lafayette Street, New York City, U. S. A.

Agents for Great Britain, Messrs. Wm. Dawson & Sons, Ltd., Cannon House, London, E. C.

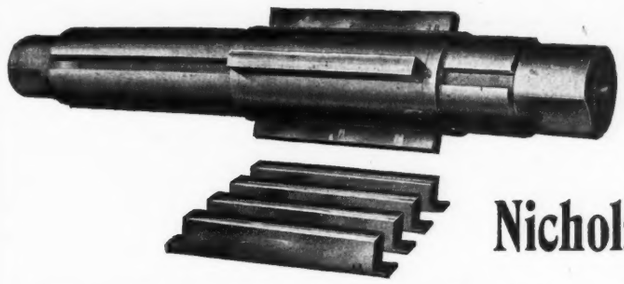
I accept Offer.....(say whether you accept A 4 or A 5) with.....Edition and will remit accordingly.

Name and Address.....

.....

Works Address.....

Complete list of Reference Books printed on back of this order blank. Mark the titles you select. All delivery charges prepaid by us.



There's No Prettier Example of Mechanical Evolution

in a small way, than the supersession of the old fashioned solid mandrels by

Nicholson Expanding Mandrels

One set of **nine** of the latter will take the place of a **ton** of the former and give you a mandrel instantly at hand to fit any hole from one to seven inches.

The surprisingly big saving of time thus effected ought to impel you to investigate this great expense-shaver and profit-maker **at once.**

And There's the Nicholson Driving Block

This companion device at a trifling cost (only $13.50) affords the easiest and quickest way of driving the Nicholson Expanding Mandrel in or out—and for all sorts of machine shop driving.

Its distinguishing feature is the leather-covered adjustable shelf, which slips into any slot desired, according to the length of the arbor, and prevents it from falling on the floor or being otherwise injured when driven out.

EXHAUSTIVE CATALOGUE FREE

W. H. NICHOLSON & CO., WILKES-BARRE, PA., U. S. A.

FOREIGN HOUSES: C. W. Burton, Griffiths & Co., London. Schuchardt & Schutte, Berlin, Cologne, Vienna, Brussels, Stockholm and St. Petersburg.

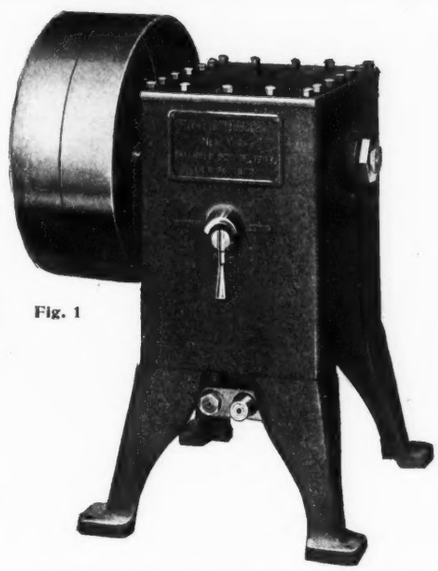


Fig. 1

The Best Ability is Reliability

Dudgeon Hydraulic Jacks and Pressure Pumps have this in good measure. Their reliability remains an unchanging quantity under all conditions of service.

The duplex double pump Cistern Power Pump shown, is self-contained and portable, and, although very small, is capable of giving a high pressure.

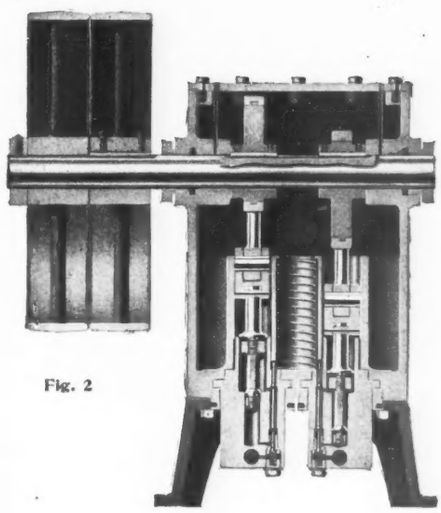


Fig. 2

Boilers and other vessels can be filled through the pump and the desired pressure easily and quickly obtained.

Dudgeon Jacks and Pressure Pumps are made in sizes, styles and capacities for every purpose, and where a power driven pump is required for high pressure this one is recommended. *Send for the complete price list and catalog.*

MADE ONLY BY

RICHARD DUDGEON, Broome and Columbia Sts., New York

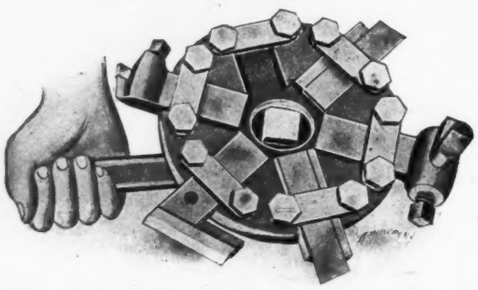
ATKINS "AAA" HACK SAW BLADES

We received the Grand Prize and Gold Medal on Hack Saw Blades at the Alaska-Yukon-Pacific Exposition.

If you will write to the nearest address given below giving specifications and class of metal cutting you do, we will send you free sample blades for comparative test. You will find Atkins "AAA" Blades more economical than any you have ever used.

BRANCHES:
Atlanta, Chicago, Memphis, Minneapolis, New Orleans, New York City, Portland, San Francisco, Seattle. Canadian Factory, Hamilton, Ont.

E. C. ATKINS & CO., Inc.
INDIANAPOLIS



Convert your Engine Lathe into a Turret Lathe or Screw Machine

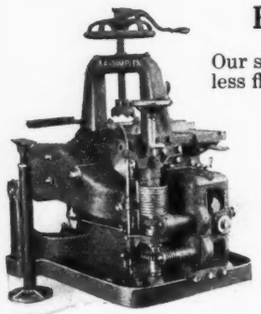
Simply bolt this Turret Tool Post to lathe and you are ready for interchangeable work. A pull down on handle locks all tools in position and by releasing handle, the Turret may be immediately revolved to tool required. Has up and down adjustment for centers of different lathes, is simple, durable, efficient and the entire attachment is made of thoroughly hardened steel.

Tool Holder Catalogue on request.

The Western Tool and Mfg Co.
Springfield, Ohio, U. S. A.

Lea Simplex Cold Metal Saws

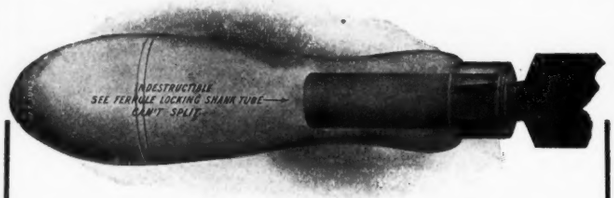
Powerful—Up-to-date



Our sprocket drive machines occupy less floor space and have a greater working capacity than arbor driven saws, use smaller blades and take a steady cut that is free from back-lash. The parts, all get-at-able. Well ribbed frame, bronze bearings, carriage and blade under instant control. Belt or motor drive and adapted for all classes of metal stock, structural steel, etc.

Several sizes—immediate delivery. Catalogue?

LEA EQUIPMENT CO., 90 West St., New York City

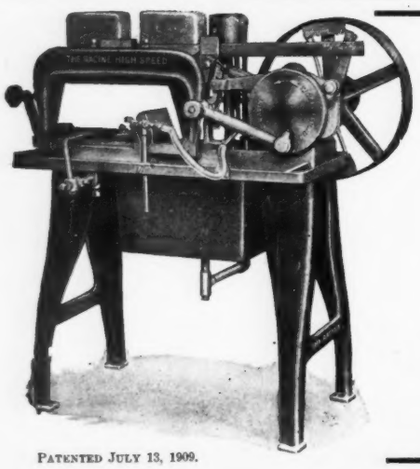


OSGOOD'S PATENT "INDESTRUCTIBLE" FILE AND TOOL HANDLES

will outlast 20 to 30 common wood handles. No metal surface touches the hand and wood cannot split and let the file shank cut the flesh. Used in many of the largest factories in the country and sent on approval to interested concerns.

6 sizes. Write for discounts and catalogue.

J. L. Osgood, 121 Erie Co. Bank Bldg., Buffalo, N. Y.



PATENTED JULY 13, 1909.

Racine High Speed Saws

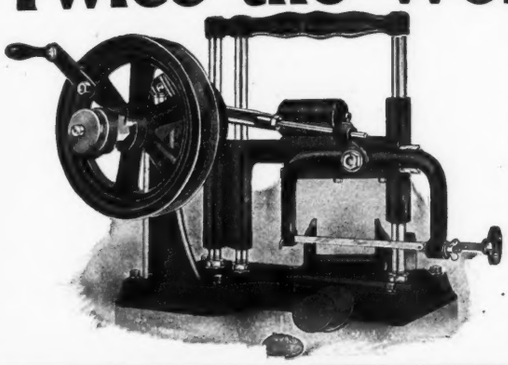
Cut your cutting cost. Will do the work of 6 ordinary machines. Successive orders prove their superiority.

Sent on 30 days' trial.

Write Dept. 47

Racine Tool and Machine Company
RACINE, WIS., U. S. A.
Successors to RACINE GAS ENGINE COMPANY

Twice the Work at Half the Cost



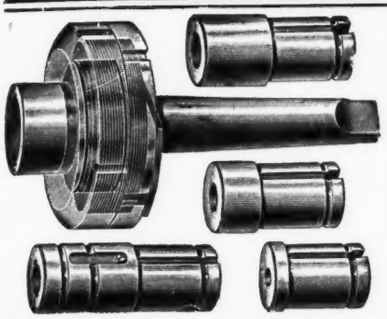
THE DUPLEX HACK SAW cuts as clean, straight and square as a die. It cuts with astonishing rapidity because the saw blade cuts its entire length and because the slide bearing in which the saw arm operates is so proportioned as to insure perfect alignment with positively no vibration, "binding," or friction. Breaking of saw blades is practically an impossibility. The "Duplex" can be operated by **Hand or Power.**

While primarily a hand machine it can be instantly converted into a powerful, high class power hack saw, by simply attaching a belt to the machine, the momentum wheel being also a pulley. It cuts any size bar up to 4" by 4".

We will send you the machine on **15 DAYS' FREE TRIAL** without cost or obligation. Price, if entirely satisfactory, to be $16.

Write to-day for further particulars.

Buffalo Specialty Co., 425 Ellicott St., Buffalo, N. Y.



The

Safety Drill & Tap Holder

is the only attachment for the purpose that gives universal satisfaction, and is

UNEQUALLED in Efficiency, Convenience, Rapidity, Accuracy and Simplicity.

Nothing to Break or get out of Order. Made in 4 sizes, covering from 0 to 2½ in. diameter.

The Beaman & Smith Co., Providence, R. I.

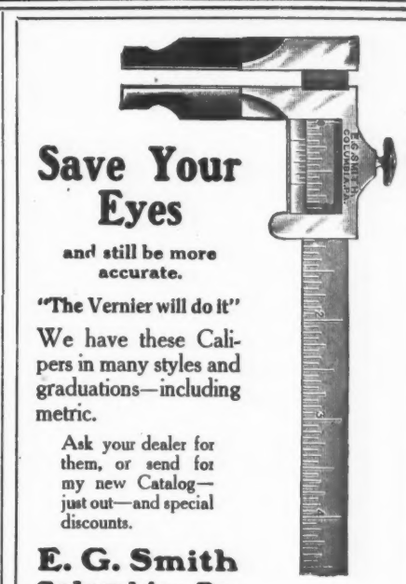
TAP MACHINERY

IS OUR SPECIALTY

We have the facilities and know the requirements.

BICKFORD & WASHBURN, Inc.

GREENFIELD, MASS., U. S. A.



Save Your Eyes

and still be more accurate.

"The Vernier will do it"

We have these Calipers in many styles and graduations—including metric.

Ask your dealer for them, or send for my new Catalog—just out—and special discounts.

E. G. Smith
Columbia, Pa.

OUR SPECIALTY,

Automatic Machinery for making Wood Screws,

Asa S. Cook Co., HARTFORD, CONN., U. S. A.

1874 TRUMP DRILL CHUCK 1910

Self centering and well made. Holds either straight or taper shank drills and bits. Readily fitted to any machine. 3 sizes, capacities from 0 to ⅛", ¼" and ⅜".

Circular.

TRUMP BROS. MACHINE COMPANY, Wilmington, Delaware

Gorton Engraving Machines

For engraving metal plates, dies, patterns, etc.—relief or sunken—in quick time and at small cost. *Write for details.*

Geo. Gorton Machine Co., Racine, Wis.

Here's the Way to Conserve Space Yet Have Stock Always Ready at Screw Machine!

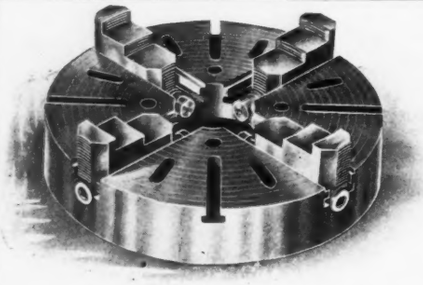
A combination stock guide and storage rack that will instantly increase the efficiency of your machines and utilize lost space.

Stock guides are adjustable and are split and hinged, hence no end hauling.

Is this not just what you have been looking for?

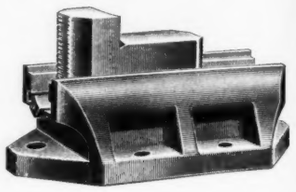
Write for Prices.

The New Britain Machine Co.
NEW BRITAIN, CONN., U. S. A.



STRENGTH AND POWER

The S. E. Horton Machine Co.'s New Four Jaw Independent Chuck is not only the strongest, the most powerful, but the most durable lathe chuck of its class. Extra strong screws, large bearing surfaces, wider jaws and a careful distribution of metal are features of the improved design which count largely in effective service. We make a full list of sizes, and for exceptionally severe conditions steel castings can be furnished for the larger chucks.



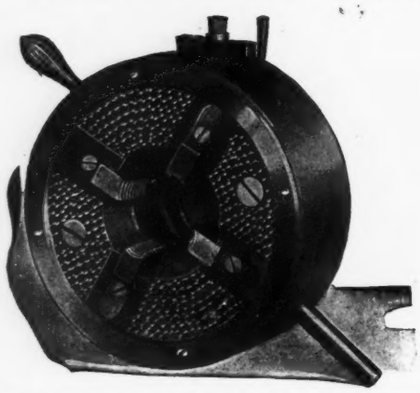
Our New Pattern Face Plate Jaws are also up-to-date propositions.

Write for special folders.

THE S. E. HORTON MACHINE COMPANY, Windsor Locks, Conn.

(Not The E. Horton & Son Co.)

30 to 50 Per Cent. Faster



You can cut screw threads from 30 to 50 per cent faster by using our

Self-Opening Dies.

Moreover, with these dies it is unnecessary to back out and possibly damage the tool, the finished thread, the machine, belts or countershaft. They cut any length thread and will work flush to a shoulder.

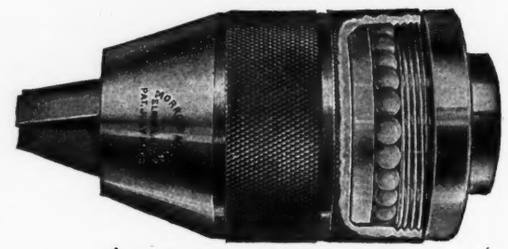
Write for full details.

Modern Tool Company, Erie, Pa.

AGENTS—The Prentiss Tool and Supply Co., 115 Liberty St., New York. Frank H. Czarniecki Co., 335 Fifth Ave., Pittsburg, Pa. O. L. Packard Machinery Co., 34 S. Canal St., Chicago, Ill., Milwaukee, Wis. C. W. Burton, Griffiths & Co., London, Eng. J. Lambercier & Co., Geneva, Switzerland. Chandler & Farquhar Co., 34 Federal St., Boston, Mass.

Large Balls and Large Bearings are the Life of Morrow Drill Chucks

They never flinch on the hardest work—only grip the drill tighter.



ALL HOODS ARE HARDENED AND GROUND

Supreme in its effectiveness, simplicity and general detail, the construction of Morrow Drill Chucks stands the test of severe usage and even abuse without accuracy or gripping power being the least impaired.

Outer case is aligned with the spindle head, lateral or end movement is entirely eliminated and the chuck is designed to avoid exposed threads. The release is a marvel of simplicity and certainty—the chuck meets all modern requirements.

Send for price list and catalog.

MORROW MFG. COMPANY, Elmira, N. Y.

For rapid, accurate and economical thread cutting or milling, you can hardly find a better tool than

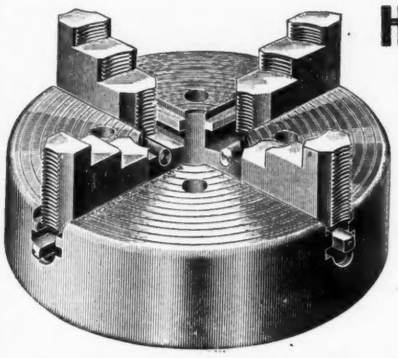
Rogers Adjustable Hollow Mill

It is simple, has few parts, adjustment is positive and quickly made, cutters can be renewed at a very small expense and the tool covers a wide range of usefulness. Five sizes.

Our Catalogue of Small Tools and High Speed List of Reamers should interest you.

THE JOHN M. ROGERS WORKS
Gloucester City, N. J.

FOREIGN AGENTS: Chas. Churchill & Co., Ltd., London, E. C. Selson Engineering Co., Ltd., London, E. C. C. W. Burton, Griffiths & Co., London, E. C. De Fries & Co., Dusseldorf, Germany. V. Lowener, Copenhagen, Denmark.



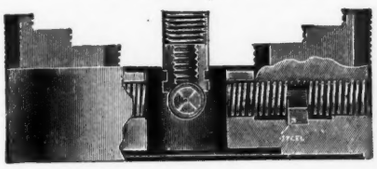
HORTON CHUCKS

Have been weighed in the balance, and
NOT
found wanting.
QUALITY
has upheld them for more than
50 YEARS.
Experience and an intimate knowledge of what is required of Modern Machine Tools enable us to furnish exactly the
CHUCK
that is needed. Buy the best: the "Just as Good" brand rarely gives satisfaction.

THE E. HORTON & SON CO., WINDSOR LOCKS, CONN., U. S. A.

Or Chas. Churchill & Co., Ltd., London, Birmingham, Manchester and Glasgow. Schuchardt & Schutte, Berlin, Cologne, Vienna, Stockholm, St. Petersburg and New York. Fenwick Freres & Co., Paris, France. Van Rietschoten & Houwens, Rotterdam, Holland. E. Hartman, Christiania.

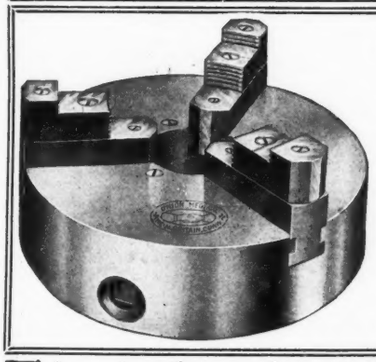
THE STEEL-REENFORCED Independent Lathe Chuck



Sectional view of the Steel-Reenforced Independent Lathe Chuck, showing the solid Steel Ring cast into the Body, and forming the Steel Bearings for operating Screws.

Buy the Steel-Reenforced Independent Lathe Chuck. You know it is stronger, therefore, must be more durable.

Oneida National Chuck Co.
ONEIDA, N. Y., U. S. A.



Geared Scroll Chucks with Reversible Jaws

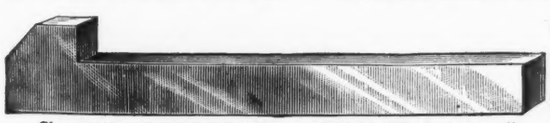
are handy and economical for some kinds of work.

The Reversible Jaw shown in cut (our No. 163) is the simplest and easiest operated of any Reversible Jaw made.

Send for Catalog.

UNION MANUFACTURING COMPANY
26 Cortlandt Street, New York — New Britain, Conn.
MAKERS OF A COMPLETE LINE OF CHUCKS

Finished Machine Keys



Gib and Plain Head

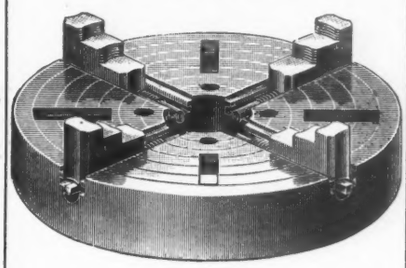
All sizes carried in stock. Write for discounts.

Cheaper than you can make them. Finished "Ready to Drive."

OLNEY & WARRIN
66-68 Centre St., New York

Machine Shop Wants

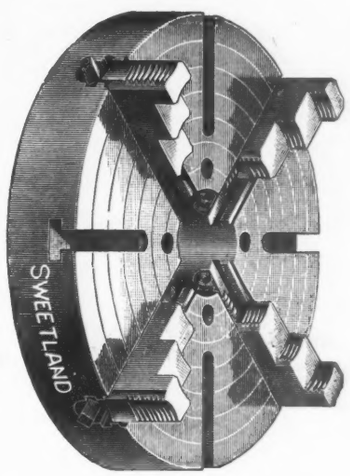
ARE FOUND IN



THE

Sweetland Lathe Chuck

Late improvements make it the strongest chuck made.



Hoggson & Pettis Co.
New Haven, Conn., U. S. A.
103 Chambers St., New York

THE SCHWERDTLE STAMP CO.,
STENCILS-BURNING BRANDS
STEEL STAMPS & DIES
SEALS-MACH. PLATES-CHECKS
BRIDGEPORT, CONN.

Spur Geared Scroll Combination Lathe Chuck.

If you want the best Lathe or Drill Chucks—buy Westcott's

Little Giant Auxiliary Screw Drill Chucks, Little Giant Double Grip Drill Chucks, Little Giant Improved Drill Chucks, Oneida Drill Chucks, Spur Geared Scroll Combination Lathe Chucks, Scroll Combination Lathe Chucks, Geared Combination Lathe Chucks, Geared Universal Lathe Chucks, Spur Geared Scroll Universal Lathe Chucks, IXL Independent Lathe Chucks, Cutting-off Chucks.

Strongest Grip, Greatest Capacity.
Great Durability, Accurate.

WESTCOTT CHUCK CO., Oneida, N. Y., U. S. A.
Ask for catalogue in English, French, Spanish or German.

Little Giant Auxiliary Screw Drill Chuck.

A Few Advantages of the Coit 20th Century Ball Bearing Drill Chuck

The Coit Drill Chuck has few parts, is simple in construction and equally simple in operation. No wrench or key is required to adjust it, a turn of the threaded mandrel sleeve serves to open or close the jaws. It is the only self-tightening, ball bearing drill chuck with round removable jaws, and the jaws can be removed without taking the chuck apart. The mandrel is part of the tool, bearings are dust proof, one oiling will serve for months.

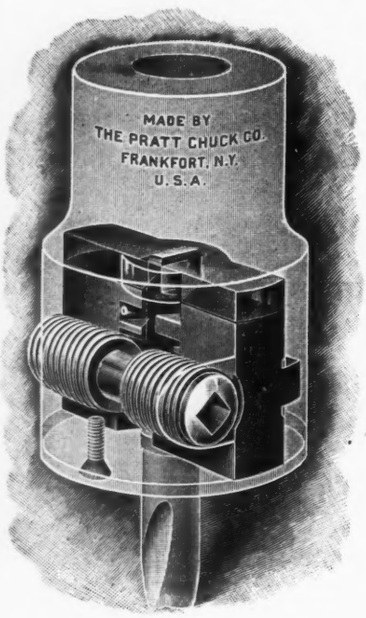
The special business of a drill chuck is to *hold the drill* and the Coit does this to perfection—no slip, no twist, no broken drill shanks; the greater the resistance on the drill, the tighter the grip of the chuck—moreover, this chuck holds short tang drills as firmly and easily as those of full length.

Made in five sizes; may we send our book?

THE STANDARD MACHINERY CO.

MYSTIC, CONN., U. S. A.

This X-Ray View of the Pratt Drill Chuck



Shows just why it always grips and never slips. Why it holds the tool firmly and easily, and demonstrates its simplicity, convenience and wearing qualities.

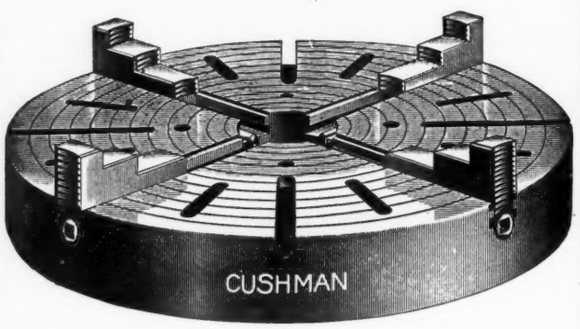
Pratt Simplicity Makes Pratt Efficiency

Latest catalogue sent on request.

THE PRATT CHUCK COMPANY
FRANKFORT, N. Y.

EUROPEAN AGENTS: Selson Engineering Co., Ltd., 85 Queen Victoria Street, London, England.

"CUSHMAN" CHUCKS



We have just issued our 1910 catalogue and price list which will be sent free upon request.

This catalogue describes fully the line of chucks we manufacture, consisting of Heavy Pattern Lathe Chucks, Drill Chucks and Face Plate Jaws.

The Cushman Chuck Co.

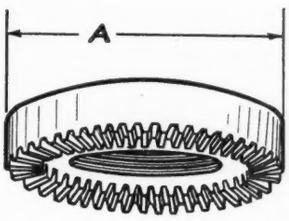
39 Ann St., Hartford, Conn.

The Solution of Every Chuck Problem

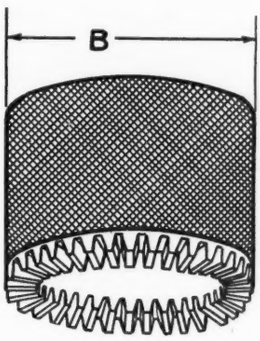
THE NEW ALMOND GEARED CHUCK

Practically Perfect

Positively Accurate



TEETH CUT ON GEARED NUT.



TEETH CUT ON GEARED FERRULE.

MERIT WHERE MERIT COUNTS

The sketches herewith presented show honest comparison with competitive drill chucks and illustrate an important feature of the New Almond Geared Chuck—the greatest leverage of any similar chuck manufactured.

SIZE	-A- THE ALMOND	-B- OTHER CHUCKS	
No. 2	1.815"	1.625"	ALMOND 5.2% MORE LEVERAGE.
No. 3	2.439"	2.312"	ALMOND 10.7% MORE LEVERAGE.

It has the additional advantage of affording direct power because the teeth are cut on the geared nut.

The body of the New Almond Geared Chuck has been designed and constructed to insure the best service, greatest convenience and economy to the user.

Keys are guaranteed against breakage.

Almond Chucks have been known and approved for 30 years.

Ask for a copy of our story, "Why the New Almond Geared Chuck Was Evolved".

T. R. ALMOND MANUFACTURING COMPANY

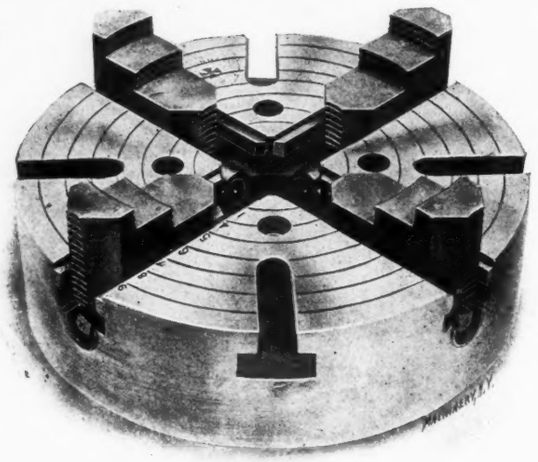
2 MAPLE AVE., ASHBURNHAM, MASS.

Cincinnati—the Independent Chuck

A CHUCK WITH NINE LIVES

Screws are mounted in hardened steel bushings which receive all end thrust and provide full bearings for the screw trunnions.

Wear and end play are also minimized by the highest grade spindle steel screws.



When worn, these bearings are quickly replaced and the Chuck is as good as new. Screws always held in line with the jaws to prevent tilting and cutting of threads. All bearings are perfectly ground and fitted by expert machinists.

Those who use them agree that the Cincinnati is the best Independent Four Jaw Chuck on the market. Write to the makers while you think of the best.

The Cincinnati Chuck Co., Cincinnati, Ohio

Chicago Office: 11-13-15 N. Canal St. New York Office: 136 Liberty St.

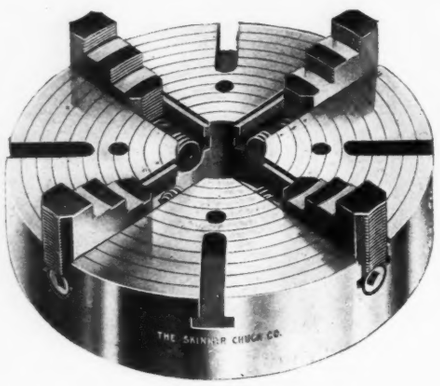


Figure 900

Buy The Skinner Independent Chucks They are Reliable

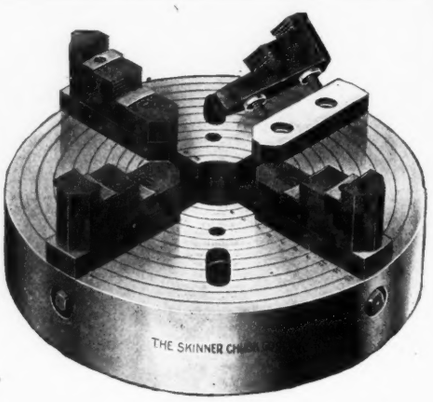


Figure 100

Our Fig. 900 Independent Chuck is made exceptionally heavy, strong and durable, and embraces all the very latest improved methods of Chuck making. It is practically impossible to improve upon the construction of this Chuck.

Hardened steel thrust bearings for taking the thrust of the jaw adjusting screws insure the Chuck long life, these bearings being practically indestructible. Because of the jaw screws being threaded their full length, the Chuck will hold much larger pieces than the rated size. The jaws are carefully hardened and, after being assembled in the Chuck body, are ground on the steps to insure accuracy. The Face of the Chuck is accurately graduated in inches.

You will not find all these features contained in any other one Chuck. Give us your next order. We guarantee you satisfaction.

Our Fig. 100 Independent Chuck is not intended for quite as heavy work as the Fig. 900, but is a very serviceable and convenient tool, being equipped with our Patent Reversible "J" Jaws. They can be reversed very quickly and without difficulty.

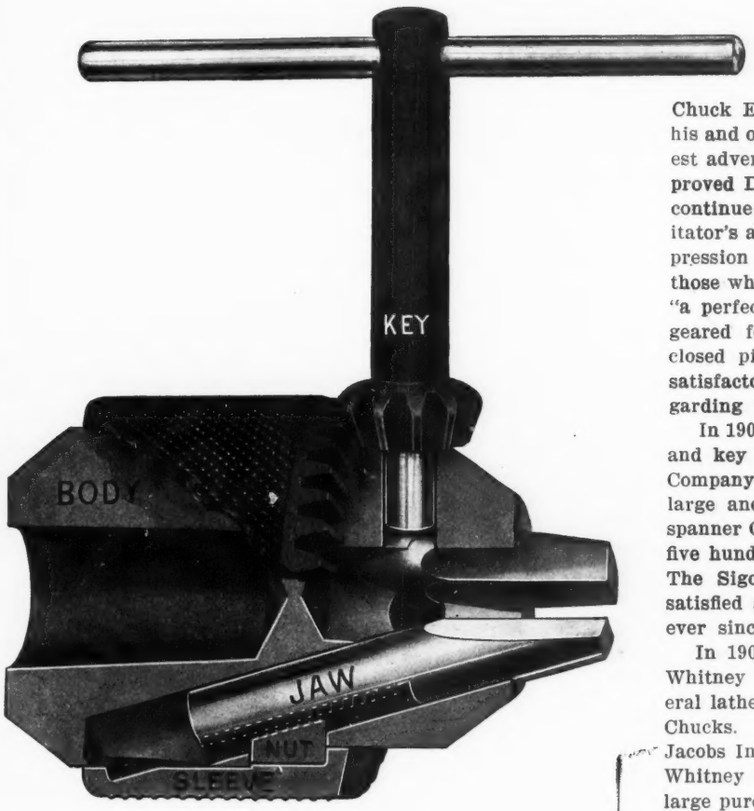
We manufacture all kinds and sizes of high grade Lathe, Drill, and Planer Chucks, Drill Press Vises, Heavy Face Plate Jaws, etc.

Write for our **free catalog.**

94 Reade Street New York City **The Skinner Chuck Co.** Factory: New Britain, Conn.

"Drill Chuck Experience"

"One way to get Drill Chuck experience is to purchase a geared ferrule Chuck, built for short service, and to use keys not guaranteed against breakage."



The above is quoted verbatim from a recent advertisement of our imitator. If this imitator would only tell the true "Drill Chuck Experience" of Drill Chuck users of his and our own make, it would be the strongest advertisement in favor of the Jacobs Improved Drill Chuck, and we could wholly discontinue our advertisement; but as this imitator's advertisement gives an erroneous impression we will, for the enlightenment of those who have tried (in the past five years) "a perfect spanner Drill Chuck," a "perfect geared ferrule Chuck," and a "perfect enclosed pinion Chuck," and found them unsatisfactory, state actual historical facts regarding "Drill Chuck Experience."

In 1902, we showed our first toothed sleeve and key Drill Chuck to the Sigourney Tool Company of Hartford Conn., (who were then large and critical users of the best known spanner Chuck), and received their order for five hundred Jacobs Improved Drill Chucks. The Sigourney Tool Company has been a satisfied and large purchaser of our Chucks ever since.

In 1903, we purchased from the Pratt & Whitney Company of Hartford, Conn., several lathes to use in the manufacture of our Chucks. We paid for these lathes with Jacobs Improved Drill Chucks. The Pratt & Whitney Company has been a satisfied and large purchaser of our Chucks ever since.

In 1903, the Hisey-Wolf Machine Company of Cincinnati, Ohio, sent to us for a sample Chuck to test on their electric drills, with the result that they adopted our Chuck as the Drill Chuck equipment for their product. The Hisey-Wolf Machine Company has been a satisfied and large purchaser of our Chucks ever since.

The fact that the Hisey-Wolf electric drills were equipped with Jacobs Chucks, led other portable drill manufacturers to adopt our Chucks; some of these because they recognized its superior merit, others, because some of their customers demanded it. To substantiate this statement we quote verbatim from a letter written to us by a portable drill manufacturer: "Our customer has finally decided that he will not accept the drills (ten portable pneumatic drilling machines), unless they are equipped with Jacobs Chucks."

Thus, we might continue stating actual experiences favorable to the Jacobs Chuck, enough to fill the whole of this paper, and then it could be said, "The half has never been told." But that is too expensive and entirely unnecessary, as tens of thousands of users of the Jacobs Improved Drill Chuck know that it is the best Drill Chuck known. If you do not know the Jacobs Improved Drill Chuck, ask any of these users about it. Ask any leading dealer about it, or, better still, purchase a Jacobs Chuck and join the happy multitude of satisfied users of Jacobs Improved Drill Chucks.

We do not claim perfection of product because we know that perfection is impossible, but our Chuck is fully guaranteed and we CHEERFULLY REPLACE, as we always have done, any of our product that is defective and does not give reasonable service.

Leading dealers all over the world sell the Jacobs Improved Drill Chuck. Ask your dealer for it. If he cannot serve you, write to us.

The Jacobs Manufacturing Company

Hartford, Connecticut, U. S. A.

1/3 THE COST OF LEATHER
THE GANDY BELT

THIS IS SURPRISING!

When we tell belt users they can get a belt which will do the same or better work than leather for 1-3 the cost, they can hardly credit it.

But—when we tell them we've been selling the Gandy Belt at this price for 32 years

And Then—when we back up these claims by all kinds of letters from actual users who show that they're getting as good or better service from the Gandy—there is no room for doubt—

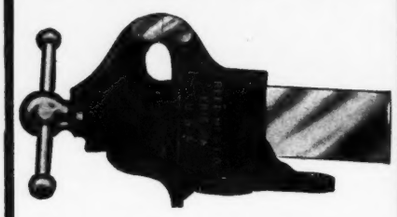
However—to make assurance doubly sure we put an ironclad *guarantee* on every inch of The Gandy Belt sold.

Now, if these facts are right you can save money—can't you?

All we ask is to let us *prove* they're right—will you drop us a line and give us this chance?

The Gandy Belting Company
737 West Pratt St., BALTIMORE, MD.

A Vise that Gives Satisfaction



In the Reed Machinists' Vise you get full value for the investment. It has a positive grip that cannot slip or loosen, a V shaped head on the clamping bolt, which works in a V shaped channel; it is strong, convenient, long wearing—a vise for full service.

Catalogue H on request.

REED MFG. CO.
Erie, Pa.

Gerstner Cases Last a Lifetime

Case Never Warps

Drawers Won't Stick

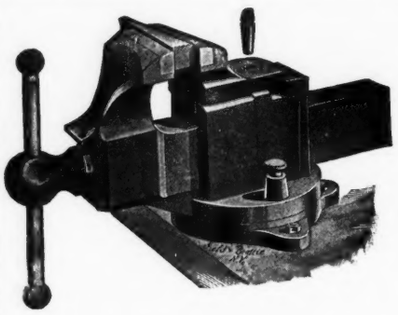
Only thoroughly seasoned wood is used in Gerstner Portable Tool Cases, so constructed that they defy racking, and any possible expansion or contraction cannot affect the drawers. The shellac finished wood is easy to clean and the felt lined bottoms keep the tools in good condition. Handsomely finished, they look well anywhere. Equipped with our self-hinging, sliding lid having a felt lined tray, a snap spring lock, comfortable leather handle, solid polished or nickeled brass trimmings, etc.

Send for catalogue and prices.

Manufacturers of Mechanics' High Grade Tool Cases

H. Gerstner & Sons. DAYTON, OHIO

815-821 Germantown St. Dayton, Ohio U. S. A.



Machinists' Swivel Vise

with self-adjusting jaw that is as strong and durable as any solid jaw, and a Swivel Bottom that gives any desired adjustment to right or left, and is solid and firm at any angle. We make all sorts of good vises, and have been leaders in this line for twenty years. Send for catalogue and price list.

Prentiss Vise Company
106-110 Lafayette St., New York

Agents for Great Britain, Chas. Neat & Co., 112 Queen Victoria St., London, E. C.

ELECTROTYPERS

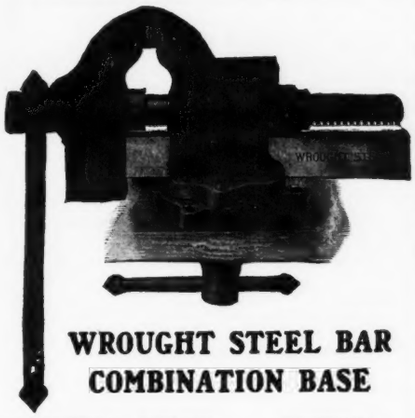
All Kinds of Plates for Printing

THE LOVEJOY CO., Established 1853. **444-446 Pearl St., New York**

ORIGINAL
ROCKWELL FURNACES
For ANNEALING, TEMPERING, HARDENING, MELTING, Etc.
FUEL OIL APPLIANCES
Catalog 21 for the asking.
W. S. ROCKWELL CO. 50 CHURCH ST., NEW YORK

RADIAL DRILLS and ENGINE LATHES

THE JOHN B. MORRIS MACHINE TOOL CO., CINCINNATI, OHIO, U. S. A.



WROUGHT STEEL BAR COMBINATION BASE

MERRILL BROS., MASPETH, NEW YORK, N. Y.

PATENT APPLIED FOR.

The Marvel DRAW CUT

HACK SAW

No. 1—Capacity, 4"x4", blade 12".
No. 2—Capacity, 6"x6" long stroke and 8"x8" short stroke. Blades 12" to 17", and swivel vise that swivels both ways. They saw fast and straight. Best and most satisfactory all around shop saw. *Send for catalogue.*

Armstrong-Blum Mfg. Co.

343 N. Francisco Ave., Chicago, U.S.A.

The Draw-Cut Machine Saws

For cutting solids, pipe, tubing, shapes, soft metals, hard or tough metals, always give results in rapid, accurate cut with minimum wear to blade.

No. 1, 6" x 6" **No. 2, 10" x 10"**

H. T. STORY

122 N. Curtis Street, Chicago, Ill.

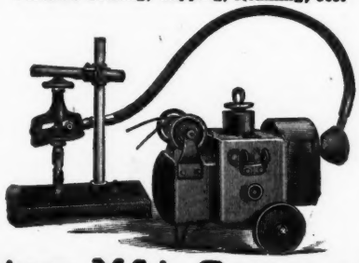
Combination of

Stow Flexible Shaft

and

Multi-Speed Electric Motor

Portable Drilling, Tapping, Reaming, etc.

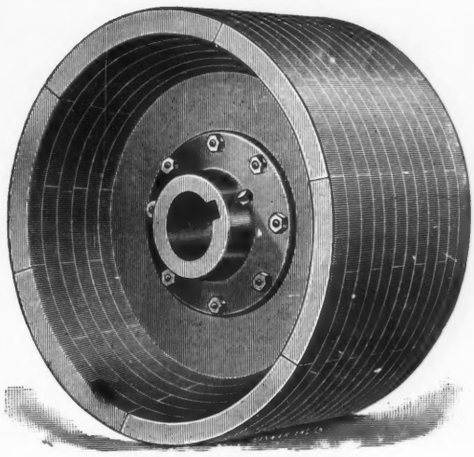


Stow Mfg. Company

Binghamton, N. Y.

Selig, Sonnenthal & Co., General European Agents, London, Eng.

Save Power and Cut Down Your Belt Expense



STYLE D. SPECIAL PULLEY

GILBERT WOOD SPLIT PULLEYS

by permitting perfect contact reduce the belt tension, reduce friction of the journals and relieve the strain on the shafting.

The hard polished wood face of the Gilbert Pulley gives an ideal belt surface—the pulley is correctly balanced, runs true, is easily put on or taken off the shaft, stands a high degree of heat or moisture and is not easily affected by shock or compression.

Style D. is a special pulley, particularly adapted for Dynamos, Trip Hammers and other severe service, and is the lightest, strongest, stiffest and best finished Dynamo pulley on the market.

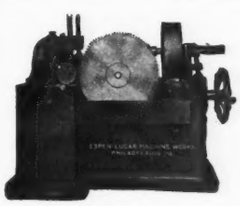
We make a full line of wood pulleys for all purposes and shall be glad to forward booklet and price list on request.

Saginaw Manufacturing Co.

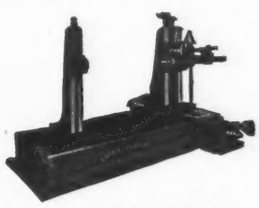
Saginaw, W. S. Michigan

SALES AGENCIES IN ALL THE PRINCIPAL CITIES IN THE WORLD

New York Branch, 88 Warren Street. Chicago Branch, 105-109 North Canal Street.
Cable Address, Engrave. A. B. C. and Lieber's Codes.



No. 7 Bar Cold Saw



No. 2 Horizontal Floor Boring Milling and Drilling Machine.

PATENTS PENDING
No. 2 I-Beam Cold Saw

WRITE FOR CATALOG

ESPEN-LUCAS MACHINE WORKS

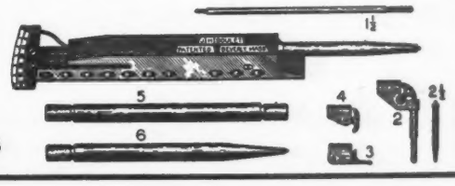
Broad and Noble Sts., PHILADELPHIA, PA.

THE NEWEST THING IN THE MEASURING LINE

Boulet's Improved Universal Micrometer Test Indicator

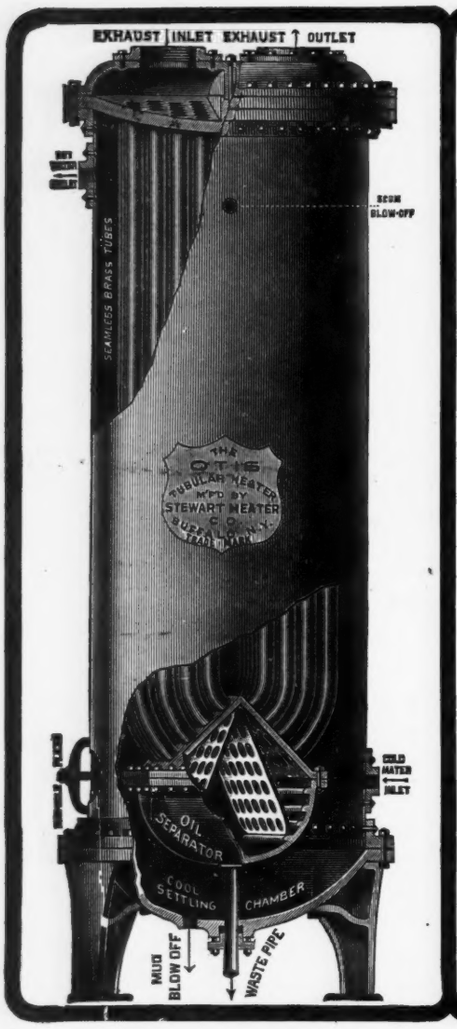
not only facilitates but simplifies an intricate testing or measuring operation. Easily read, always accurate and reliable. English or Metric measure. Will reach 75 per cent more (in intricate tests) than any tool on the market of a similar character. Strongly endorsed by an up-to-date manufacturing plant where 280 are in use.

Booklet and circular free.



BOULET'S FINE TOOL WORKS

55 BROADWAY, BEVERLY, MASS.



THE OTIS

Tubular Feed Water Heater, Oil Separator and Purifier

is not an experiment but a tried and trusted appliance that the makers are not afraid to

GUARANTEE

To heat the feed water to the *boiling point* (210 to 212 degrees) with the exhaust steam without causing any back pressure, *also to extract the oil from the exhaust*, so that the exhaust steam after being passed through the heater can be used for heating purposes, and the water of condensation for the heating system be returned to the boiler without the *additional expense* of an *eliminator*.

We are so sure of the OTIS that we agree to pay all cost of a trial—freight, cartage, piping, etc.—if it fails to do all we claim for it.

Catalogue and Prices at your Service

The Stewart Heater Company

79-99 East Delevan Ave., BUFFALO, N. Y.

POOLE ENGINEERING & MACHINE CO.
ENGINEERS, FOUNDERS AND MACHINISTS.
BALTIMORE, MD.
MANUFACTURERS AND DESIGNERS OF ALL KINDS OF
HEAVY MACHINERY.
REQUIRING FIRST CLASS WORKMANSHIP AND MATERIALS.
BAND, ROPE AND FLY WHEELS. FRICTION CLUTCHES. SHAFTING, PULLEYS AND HANGERS.
MACHINE MOLDED AND PLANED GEARING.
MACHINERY for WHITE LEAD and FERTILIZER WORKS, GRAIN ELEVATORS, FLOUR MILLS, BRASS, COPPER TIN PLATE ROLLING MILLS, CABLE and MARINE RAILWAYS.
POOLE-LEFFEL TURBINE WATER-WHEELS
DREDGING MACHINES.
CIRCULARS ON APPLICATION.
IRON CASTINGS 30,000 LBS. TENSILE STRENGTH

HANDY OILERS

Pat. July 29, '07.

No plugging up.
Oil tight and dust proof.

Bay State Stamping Company
WORCESTER, MASS.
European Agents
Chas. Churchill & Co., London, Eng.

Send For Estimates.

DROP FORGINGS,

Iron, Tool Steel, Machinery Steel, and Copper.

THE WYMAN & GORDON CO.

WORCESTER, MASS. CLEVELAND, OHIO.

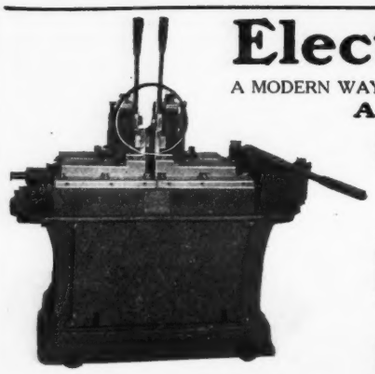
(Style of 12 and 24 Sizes.)

Measuring Machines

Measuring screw, 10, 16 or 20 threads to the inch, graduated to read thousandths or 32ds without calculation.

The only Micrometer that will not lose its accuracy by wear.

SYRACUSE TWIST DRILL CO., SYRACUSE, N. Y.
Chas. Churchill & Co., London, Eng., Agents for Great Britain.



Electric Welding

A MODERN WAY YET NOT NEW. QUICKEST—CHEAPEST—BEST

A Quantity Proposition

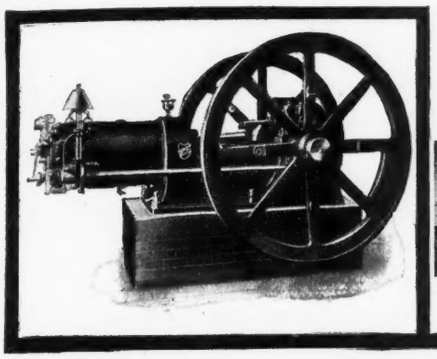
Not a quantity of shapes and sizes, but a quantity of one shape of limited sizes. For hundreds or thousands of the same thing every day, there is no way equals the electric way.

NO SMOKE, HEAT, DIRT OR GLARE
EASY—SWIFT—SURE
NO EXPENSIVE OR EXPERT WORKMAN
A BOY CAN DO IT

Describe the shape, tell us the size of the smallest and largest piece, the maximum number of welds required per day, the cost of current per k. w. hour, we will then tell you what it will cost you to electric-weld. If you haven't an alternating current, your local Lighting and Power Company has.

CURRENT OFF BETWEEN WELDS
WE JOB WELD ALSO

Thomson Electric Welding Co., Lynn, Mass.
The Pioneer Manufacturers **Beware of Infringers**



READ THIS.

OTTO GAS ENGINE WORKS.

Gentlemen:—I think it was during the spring of 1904 that we commenced the operation of Parsons Gravity Coaling Plant which you built, and I believe you installed the thirty horse power Otto gas engine which operates this plant. It is my idea to give credit where credit is due, and I am writing you this to tell you of the remarkable performance made by this gasoline engine.

This same engine has been in continuous service since that time, and we have had some temporary repairs made but once; and a great deal of the time we have used it night and day, and never has it failed us; and I thought that you would be glad to know of one of your engines which has proved so satisfactory. In my opinion this is the best gasoline engine on the market.

Yours truly,
MISSOURI, KANSAS & TEXAS RAILWAY CO.
Signed, J. R. Hibben.

McLAIN Co.

Why OTTO Products are Cheapest

FIFTH REASON

The real reason Otto Products are cheapest is not that their first cost is less but that they will give so much longer and better service.

The picture above illustrates just one reason which would probably in itself alone save the small difference between the Otto's first cost and that of cheaper engines.

It is one of the extra values characteristic of the Otto Products.

This advantage is the extra thickness of the walls of Otto cylinders.

Every gas engine cylinder sooner or later requires reboring.

Well, the Otto is sufficiently thick to permit of reboring four times should conditions under which it is run make it necessary.

Link this advantage to the fact that the Otto cylinder head, cylinder, water jacket and frame are cast in separate parts instead of a unit so that the cylinder may be immediately removed by anyone with a monkey wrench, and you'll realize one of the reasons why Otto Engines are the cheapest for you.

Now we've attached a coupon right to this ad. so that all you'll have to do to get the rest of the Otto facts, catalog, etc., is to sign your name and slip it in an envelope to us today.

We can save you money and now's the time you want to start, so please mail the coupon.

COUPON

Gentlemen:—Replying to your ad. in MACHINERY, August, send me catalogs, etc., together with approximate estimate for installing an Otto Engine of.....H. P.

Name.....

Firm Name.....

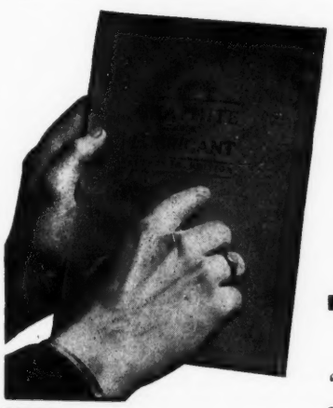
Address.....

To be used for.....

Would fuel be natural gas, manufactured gas or gasoline?.....

Otto Gas Engine Works, 3219 Walnut St., Philadelphia, Pa.

BRANCHES—Chicago, Boston, New York, Pittsburg, Omaha, Kansas City, Minneapolis, San Francisco.



Write for Free Copy 74-C

"Graphite as a Lubricant" (1910) is an authoritative, carefully prepared work on the use of lubricating graphite for practically all classes of machinery.

This newest edition gives enough insight into the technical and scientific aspects to show how and why graphite lubricates, but not enough to be dull.

Information on how to apply graphite to **your** work will be found here.

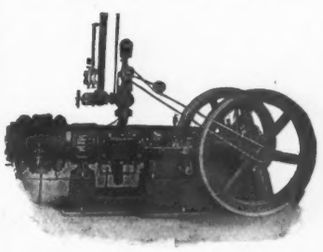
Write for free copy by number, 74-C.

Joseph Dixon Crucible Co.
JERSEY CITY, N. J.

"DALLETT" AIR COMPRESSORS

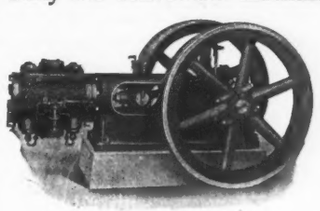
ARE SIMPLY BUT SUBSTANTIALLY BUILT

The smooth, quick and uniform action of the inlet and discharge valves insures efficient service and long life.



Especially adapted for use in factories and shops where a high class machine is desired.

They are convenient machines, having all working parts, and parts requiring adjustment, readily accessible.



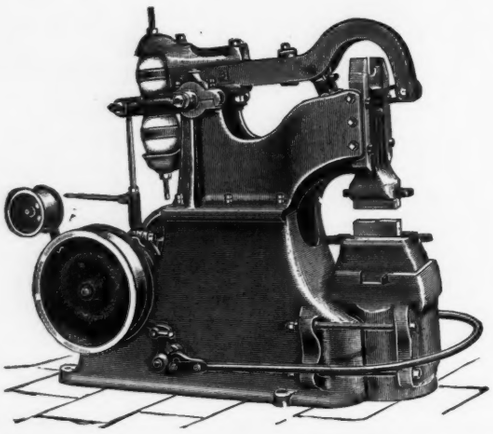
SINGLE
DUPLEX
COMPOUND

Belt, Steam and Motor Driven.

Catalogue No. 100.

Thos. H. Dallett Co.

York and 23d Streets, PHILADELPHIA, PA.



Bradley Upright Hammers

Are made with heads weighing 15 to 500 pounds. Each contains one-third to one-half more material than those of any other make of the same rating.

Their anvil blocks weigh nearly or quite double those of other hammers.

Their output is guaranteed 25 per cent. greater than is possible with other hammers of same rating or no sale.

More Bradley Hammers are sold each year than all other power hammers combined.

WE MAKE

The Bradley Cushioned Helve Hammer. The Bradley Upright Helve Hammer.
The Bradley Upright Strap Hammer. The Bradley Compact Hammer.
Forges for Hard Coal or Coke.

SEND FOR CIRCULARS.

C. C. Bradley & Son, Syracuse, N. Y., U.S.A.

FOREIGN AGENTS: Schuchardt & Schütte, Berlin, Vienna, Stockholm, St. Petersburg. Alfred H. Schütte, Cologne, Brussels, Liege, Paris, Milan, Bilbao. Buck & Hickman, Whitechapel Road, London.

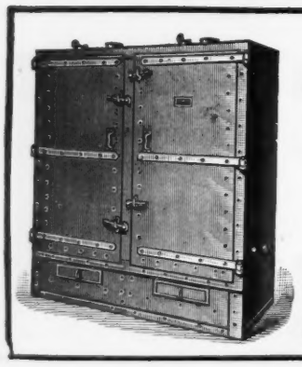
HEAVY STEEL DOG

With Steel Screws, U. S. Standard. Points Hardened. Write for my NEW CATALOG, which shows my line of Lathe Dogs, Clamps and Expanding Mandrels.

WM. G. LeCOUNT, Norwalk, Conn.

"CINCINNATI" PUNCHES

THE CINCINNATI PUNCH & SHEAR CO., Cincinnati, Ohio



THE STEINER JAPANNING AND DRYING OVEN

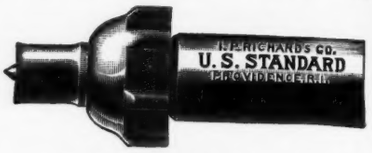
Designed to meet special conditions. Heated by gas and adaptable for many lines of manufacture. Special burners used for drying materials containing much moisture.

Ovens for
Bronzing, Japanning, Baking, Enameling, Drying.
Made in any size required. Send for Catalog.

EMIL E. STEINER, 58 Union St., Newark, N. J.

I. P. RICHARDS COMPANY

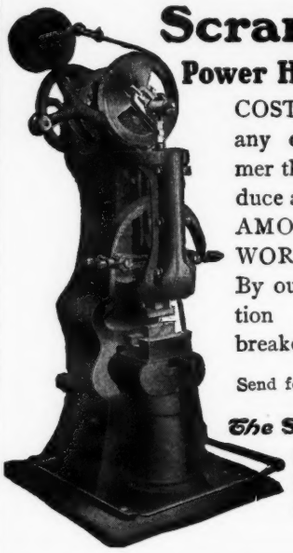
U. S. Standard Punches



For all Structural Work

PROVIDENCE, R. I., U. S. A.

Scranton Power Hammers



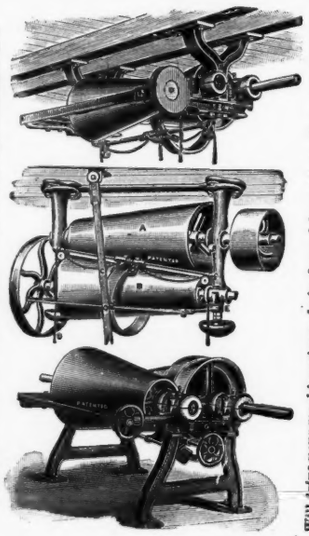
COST LESS than any other hammer that will produce an EQUAL AMOUNT OF WORK.

By our construction we avoid breakdowns.

Send for Circular 37.

The Scranton & Co. New Haven, Conn.

Evans Friction Cone Pulleys
VARIABLE SPEED COUNTERSHAFTS

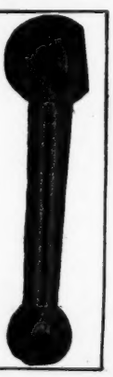


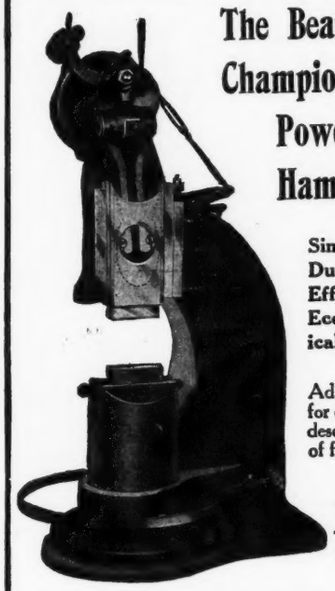
Will drive your machine at any desired speed from 1 to 6. Over ten thousand sets in operation in this country and Europe. Send for catalog. **G. F. Evans, Newton Center, Mass.**

COMPARE with your present Handle costs, our Prices for Ball Cranks and Machine Handles of every description, from bar steel. Accurate, highly finished, complete in every detail and ready to attach.

The Cincinnati Ball Crank Co.
Cincinnati, Ohio

Successors to this dept of the SCHACHT MFG. CO.





The Beaudry Champion Power Hammer

Simple
Durable
Efficient
Economical

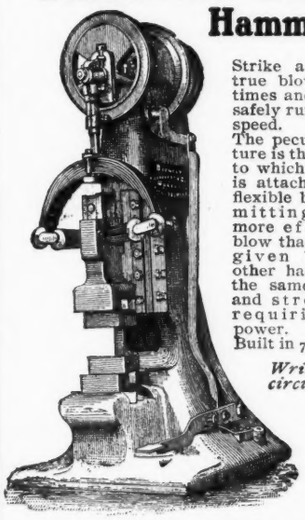
Adapted for every description of forging

Send for circular

BEAUDRY & CO., Inc.

141 Milk Street, BOSTON, MASS.

"Dead Stroke" Power Hammers



Strike a square, true blow at all times and can be safely run at high speed.
The peculiar feature is the spring, to which the ram is attached by a flexible belt, permitting a far more effective blow than can be given by any other hammer of the same weight and stroke, and requiring less power.
Built in 7 sizes.

Write for circulars.

MANUFACTURED BY

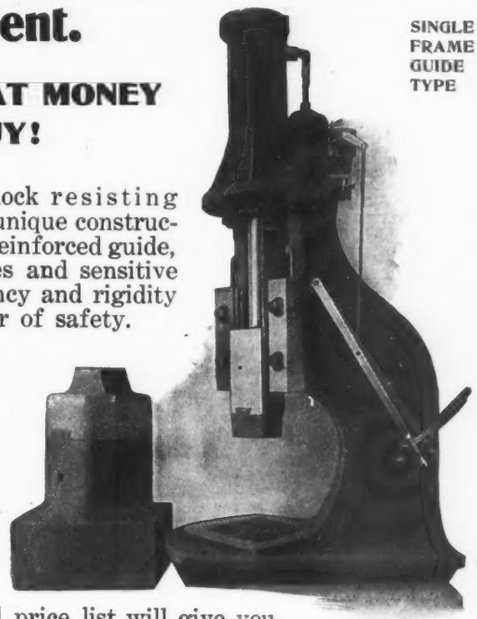
Dienelt & Eisenhardt, Inc.

1304 No. Howard St.

Philadelphia, Pa., U.S.A.

Bell Power Hammers—Sensitive—Rigid—Efficient.

THE BEST THAT MONEY CAN BUY!



SINGLE FRAME GUIDE TYPE

Special high tensile, shock resisting metal for our castings, unique construction, stiffened column, reinforced guide, improved balance valves and sensitive control, combine efficiency and rigidity with a very high factor of safety.

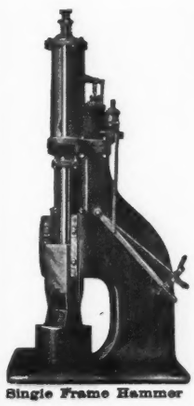
Bell Hammers, either steam or pneumatic, are designed to give continuous service on the hard, tough grades of steel in modern use without straining the frame or jarring the sensitive control out of adjustment.

Our new catalogue and price list will give you some important pointers on reducing production costs. Send for a copy.

We make all types and sizes of Steam Hammers and will send full descriptions on request.

Buffalo Foundry and Machine Company

63 WINCHESTER AVENUE, - - BUFFALO, NEW YORK



Single Frame Hammer

ERIE HAMMERS

Single Frame, 250 lbs. to 3,000 lbs.
Double Frame, 600 lbs. to 10,000 lbs.
Steam Drop Hammers, 400 lbs. to 7,000 lbs.
Plate Shears

ERIE FOUNDRY COMPANY

Erie, Pa., U. S. A.

STEAM HAMMERS

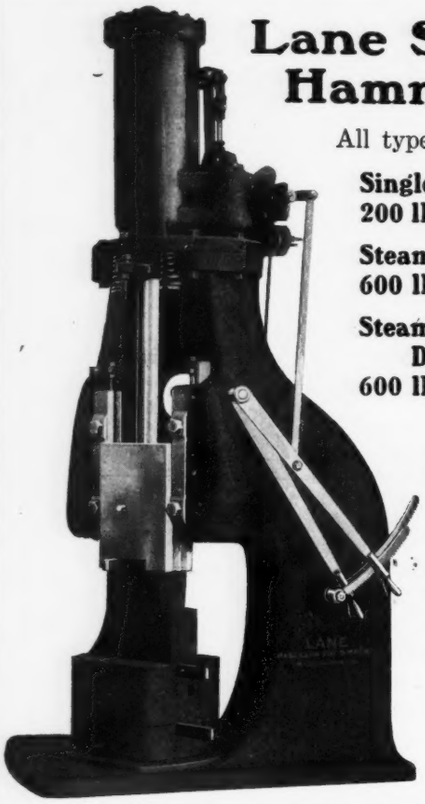
"All sizes for every class of service and work"
STEAM DROP HAMMERS OUR SPECIALTY

CHAMBERSBURG ENGINEERING COMPANY

CHAMBERSBURG, PA., U. S. A.

Trimming Presses—Flanging Presses both Four Post and Sectional Types
Hydraulic Riveters—Cranes. Accumulators—Pumps—Punches—Shears

HYDRAULIC MACHINERY



Lane Steam Hammers

All types and sizes.

Single Frame—
200 lbs. and up

Steam Drop—
600 lbs. and up

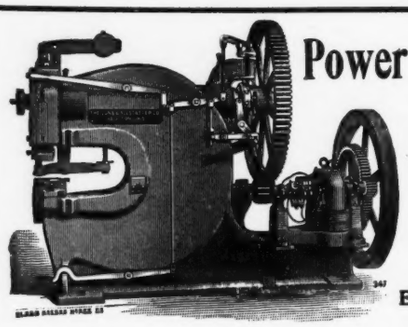
Steam Gravity Drop—
600 lbs. and up

Also special hammers for forming steel wheelbarrow trays, drag scrapers, etc., etc.

Send for new Catalogue.

THE MASSILLON FOUNDRY & MACHINE CO.
MASSILLON, OHIO

GENERAL AGENTS: The W. M. Pattison Supply Co., Cleveland, O. The E. A. Kinsey Co., Cincinnati, O. Baird Machinery Co., Pittsburg, Pa. Hill, Clarke & Co., Inc., Boston, New York and Philadelphia. Pacific Coast Mfg. Co., Los Angeles, Cal.



Power Punching and Shearing Machines

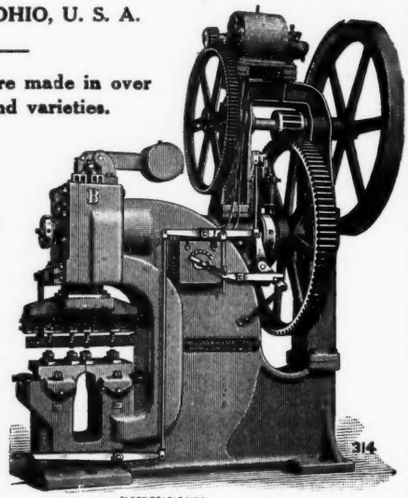
Belt, Steam and Electrically Driven.

LONG & ALLSTATTER CO.

HAMILTON, OHIO, U. S. A.

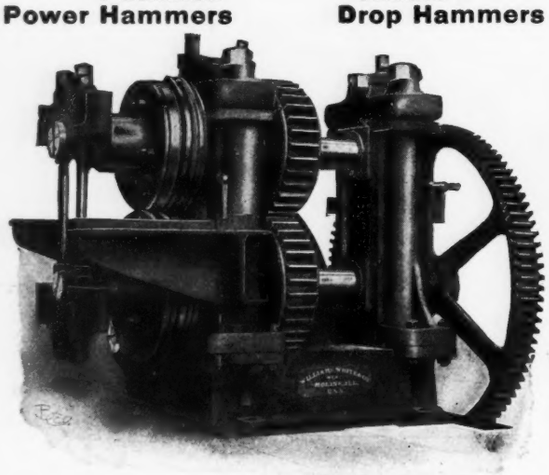
Our machines are made in over 350 sizes and varieties.

SINGLE,
DOUBLE,
UPRIGHT,
HORIZONTAL,
GATE,
MULTIPLE,
FOR
Railroad Shops,
Locomotive Shops,
Bridge Works,
Etc.



MOLINE FORGING TOOLS

Upsetters **Bulldozers**
Eyebenders
Punches **Shears**
Power Hammers **Drop Hammers**



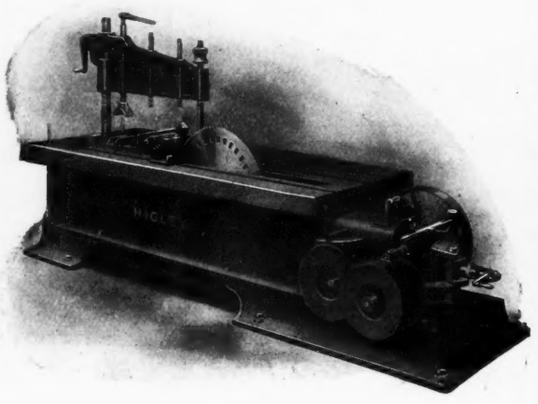
No. 1 TAPER ROLL

Tapers more Brake Levers and Plow Beams per day than any other machine.

Williams, White & Co., Moline, Ill.
Pittsburgh, Pa. Office: 808 House Bldg.

Agents in Great Britain, C. W. Burton, Griffiths & Co., Ludgate Square, Ludgate Hill, London. Agents in Austria, Schuchardt & Schutte, Vienna. Agents in France, Fenwick Freres & Co., 8 Rue de Rocroy, Paris.

HIGLEY



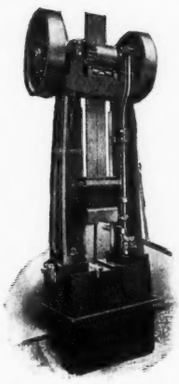
The Higley Metal Saw is built in 16 sizes. Over 2,000 in use.

Vandyck Churchill Company

NEW YORK PITTSBURG
NEW HAVEN PHILADELPHIA

Drop Forging Machinery

Drop Hammers, Trimming Presses and Dies.



Stiles Automatic Friction Roll Drop Hammer.

STILES DROP HAMMERS—are rapid and accurate. They are strongest where most strength is required. They are quickly adjusted for any height dies, and have extra wide space between uprights. The hammer always picks up on rebound. The bottom stop is cushioned and prevents bumping a hole in the lifting board.

BLISS TRIMMING PRESSES—have frames of unusual strength, very large diameter hammered steel shafts and unusually long gibs insuring perfect guidance of slide. The connections are strong, and all adjustments are convenient and easily made.

Bliss Trimming Press for Drop Forgings.

Drop Forging Machinery Catalogue No. 13A on request.

5 ADAMS STREET, **E. W. BLISS CO.** BROOKLYN, N. Y., U.S.A.

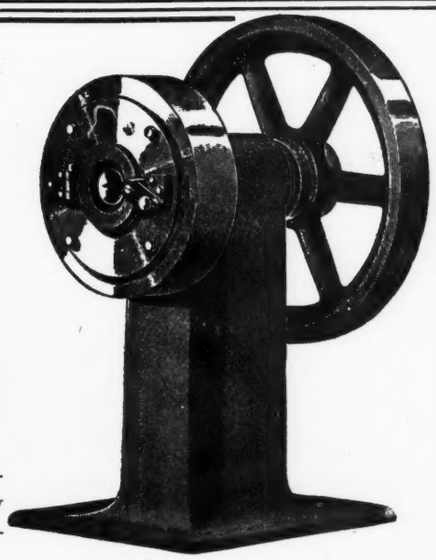
Representatives for Chicago and Vicinity: Stiles-Morse Co., 562 Washington Boulevard, Chicago, Ill.
European Office: 100 Boulevard Victor Hugo, St. Ouen (Paris), France. London Office: 114 Queen Victoria St., London, E. C., England.

2000 to 6000 Blows Every Minute

Are struck by a

Dayton Swaging Machine

giving a reduction by pressure—not by blows.



The result is a steady flow of metal, allowing a readjustment of the molecules, preventing all warping, straining, unevenness, and all with no waste of material such as follows reduction by grinding, milling, or by other methods, and the finished pieces more nearly uniform.

Get our book "The Modern Art of Swaging".

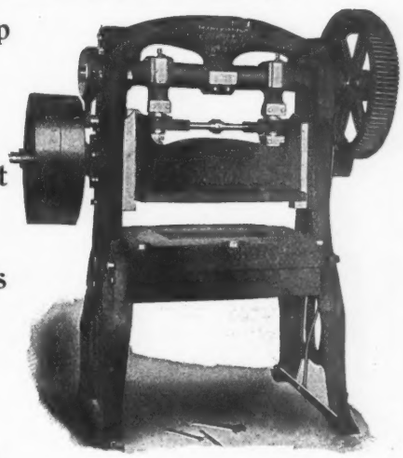
THE EXCELSIOR NEEDLE CO.
TORRINGTON, CONN.

Coventry Swaging Co., Ltd., White Friars Lane, Coventry, England, Agents for Great Britain. Fenwick Freres & Co., 8 Rue de Rocroy, Paris, France, Agents for France, Italy, Belgium, Spain, Portugal and Switzerland.

There's something in a name when it stands for the BEST and LATEST IMPROVEMENTS.

SWAINE PRESSES

always keep ahead of the procession and have just introduced improvements which will put money in the buyer's pocket, and double the life and service of each machine.



No. 73. Double Crank Press

Write Swaine, St. Louis, for catalog and estimates on any style press.

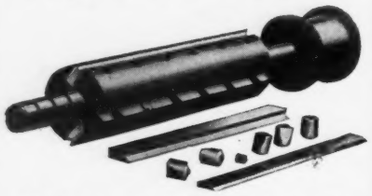
Fred. J. Swaine Mfg. Co.
7th and O'Fallon Sts., ST. LOUIS, MO.

TAKE NO CHANCES

USE

A CRESCENT JOINTER WITH SAFETY HEAD

You run no risk of losing your fingers or a hand when using a CRESCENT Safety Head.



The knives in the CRESCENT Safety Head are made of high speed steel which holds the edge longer and turns out better finished and more accurate work than can possibly be done on a common jointer with ordinary knives.

The Price is Reasonable

Write today for our 1910 catalog giving complete description of our elegant line of Band Saws, Saw Tables, Jointers, Borers, Shapers, Planers and Matchers, Circular Saws, Swing Cut-off Saws, Disc Grinders, Variety Wood Workers, etc.

THE CRESCENT MACHINE CO.

55 Main St., Leetonia, Ohio, U.S.A.

Franklin Die-cast Parts

What is Franklin Casting?

The finished piece comes direct from the molten metal, producing by casting what the machine does by tooling, accuracy to the one-thousandth part of an inch—that is Franklin casting. It is also double distilled economy if you have small duplicate work to get out.

Write for our new booklet C, which tells all about the Franklin process of die casting. It will be worth your while.

Franklin Manufacturing Company
203 South Geddes Street, Syracuse, N. Y.

Metal Polish

Highest Award
Chicago World's Fair, 1903
Louisiana Purchase Exposition, St. Louis, 1904

3-oz Box for 10 Cents
Sold by Agents and Dealers all over the world. Ask or **write for FREE samples**

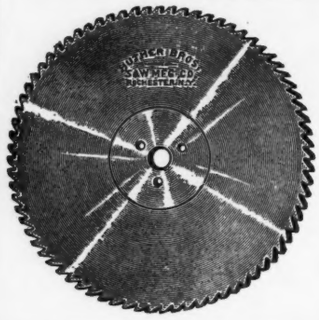
5 lb. Pails, $1.00

GEO. W. HOFFMAN
Expert Polish Maker
Indianapolis, Indiana

Sames' Pocket-Book of Mechanical Engineering

A concise digest of Mechanical Engineering Science, dealing with the widest variety of topics. Exceptionally strong on Machine Design, covering more ground than any book in English exclusively devoted to the subject. Third edition, morocco, $2.00, postpaid. Write for circular.

C. M. SAMES
342 Bramhall Ave., Jersey City, N. J.



MILLING SAWS
And Cutters

Saws made from High Speed and Carbon Steels.

LET US SEND YOU ONE TO COMPARE RESULTS OBTAINED.

Huther Bros. Saw Mfg. Co.
ROCHESTER, N. Y., U. S. A.
We also Manufacture Sheet Steel Specialties.

Brubaker Screw Cutting Tools

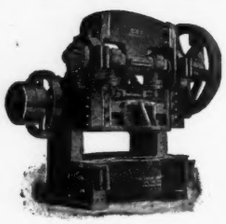
MADE TO SATISFY—NOT JUST TO SELL

Full line

Quality Product

Get latest Catalogue

W. L. BRUBAKER & BROTHERS, Millersburg, Pa.
F. E. Harrison, Eastern Representative, 50 Church Street, New York



"Toledo" No. 208 C

"YOU WANT THE BEST—BUY OF US"

"TOLEDO" Dependability

PRESSES, SHEARS, HAMMERS
DIES, SPECIAL MACHINES

MODERN TOOLS which help manufacturers to the MODERN WAY of turning out their work, with PROFITS such as the present demands.

No. 208C is just one of our many sizes and styles of Double Crank Presses. With the Special Bed and Stroke it is well adapted to blanking, drawing, forming and perforating on heavy steel wagons, running gears and supports, agricultural implements and similar work.

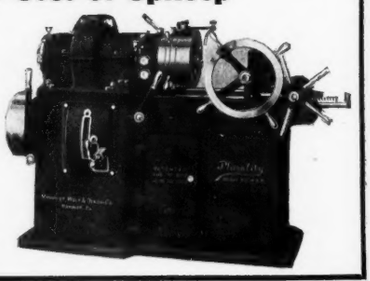
The Toledo Machine & Tool Company, Toledo, Ohio, U. S. A.

Agents—Ludw. Loewe & Co., Berlin, Ger. The Selson Eng. Co., 85 Queen Victoria St., London

"Plurality" High Power Bolt Cutters—
Distinguished for Low Cost of Upkeep

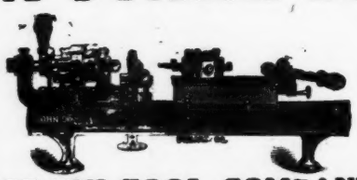
Simplicity, strength, and durability are strong points in this machine. They have the minimum number of parts—for example, three pieces or one set of "Plurality" Dies equals 48 to 96 pieces in other machines. They cut all threads from ¼" to 1½", doing twelve times the work and saving money on every operation.

Our catalogue by mail.



Mummert, Wolf & Dixon Co.
HANOVER, PA.

A STARK BENCH LATHE



Will soon show its worth in the shop where accurate work is essential

STARK PRECISION TOOLS

are made from finest materials, by skilled workmen and from up-to-date designs.

Ask for catalogue B

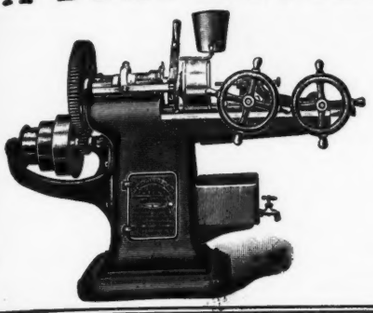
STARK TOOL COMPANY, Waltham, Mass, U. S. A.

Modern Pipe Machines.

Our line of Pipe Threading and Cutting Machines is up-to-date in every particular. Designed for labor-saving and increased output. The Machines of the hour. Write us.

The Stoever Foundry & Mfg. Co., Myerstown, Pa.
NEW YORK OFFICE: 140 Cedar Street.

A BOLT CUTTER IS MUCH LIKE A MAN IN THIS:



The Head is Nearly Everything

The Merriman Bolt Cutter Head is Noted for

1. Simplicity of the head; Only four parts, consequently,
2. Great Durability. Few repairs needed.
3. Square Bearing of the Dies in the Ring; consequently,
4. Solidity of the Dies like a Solid Die; Consequently,
5. Uniformity of the product; Bolts all the same size.
6. Effectiveness of Operation; Cheapest help can understand and run it.
7. No machine turns out work more rapidly.

THE H. B. BROWN CO., EAST HAMPTON, CONN.

Send for Catalog No. 12.

SECTIONAL BLUE PRINT

FILING CABINET

You can buy one section or ten and add to them as your business demands. Perfectly made of best oak. These cabinets can be used for a variety of purposes, and should be in every office. We also make all kinds of draughting-room furniture and our prices are right. Send at once for our descriptive matter and prices.

Fritz Mfg. Co., 60 Alabama St., **Grand Rapids, Mich.**

POWER

Is your Engine or Motor developing its full power? You don't know unless you know the speed you are attaining.

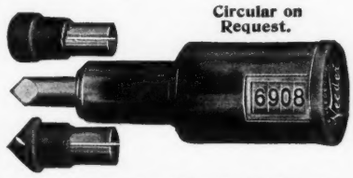
Why not determine this by taking readings occasionally with the

Veeder

SPEED COUNTER

Price $3 each. Fully Guaranteed.

Circular on Request.



Straight Reading, Non Magnetic, Ball Bearing, Clutch Mechanism which insures accurate readings.

THE VEEDER MFG. CO.

39 Sargeant St., HARTFORD, CONN.

MAKERS OF

Cyclometers, Odometers, Tachometers, Tachodometers, Counters and Die Castings.

The Recording Register & Fare Box Co.

NEW HAVEN, CONN.

"USE-EM-UP"

Drill Sockets and Sleeves

AMERICAN SPECIALTY CO., Chicago

"Loew Victor" Pipe Machines are Completely Equipped—No Extras Required

The initial cost is the only expense for an extended period of service. Particular attention has been given to durability and operating convenience, making the cost for equal service hardly one-half that of more expensive and more complicated machines.

The largest and best concerns in the country today have installed "Loew Victor" Pipe Machinery after stringent efficiency tests, and with each installation they establish new production records.

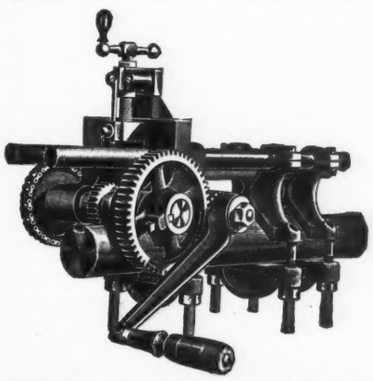
Your choice of drives—belt, gas engine or motor.

Catalogue gives the details.

THE LOEW MANUFACTURING CO.,
CLEVELAND, OHIO

EASTERN REPRESENTATIVE: N. G. Rost, 150 Nassau Street, New York City.
WESTERN REPRESENTATIVE: W. S. Merick, 6 South Market Street, Chicago.

$40. F. O. B. New York.



This No. 1 Portable Shaft Keyseater

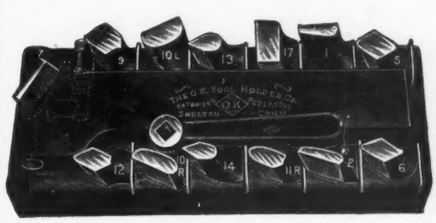
is indispensable to the repair shop. It will mill keyseats in the middle or on the ends of shafting from 1¼" to 5" in diameter without removing from the hangers. It can be slipped over heavy shafting or spindles when desired; can be operated in the most awkward places, and will mill a keyseat 12" long without resetting.

Other advantages are its rapid operation, accuracy of work produced and the fact that it cuts without jar or chatter of any kind.

We shall be glad to send full details on request.

JOHN T. BURR & SONS, 429 Kent Ave., Brooklyn, N. Y.

Selig, Sonnenthal & Co., London



Send for our new catalogue and learn how to save money on Turning Tools.

The O.K. Tool Holder Co.
SHELTON, CONN., U.S.A.

All genuine Armstrong Tools bear this trademark. Look for it and insist upon having it.

Genuine Armstrong Stocks and Dies

BUILT FOR ACCURATE WORK. BUILT FOR HARD WORK.

Engineers and Steam Fitters demand the best.

For sale by ALL LEADING JOBBERS in the country.

The complete catalog mailed upon request.

The Armstrong Mfg. Co., 297 Knowlton St., Bridgeport, Conn.

You know what you want—see that you get what you ask for.

LISTEN—

No manufacturer or contractor or plumber, who ever gave the

Merrell Pipe Threading and Cutting Machine

a fair, square trial in his own plant, will admit that there is a pipe threading machine that will do all that the MERRELL will do.

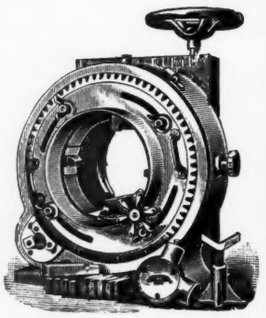
That is the one reason why we are so willing and eager to send you a MERRELL—for a 30 Day Trial at OUR expense. The MERRELL makes good—or we make good. The MERRELL threads iron or steel pipe with equal ease. Right or left thread—quick changes from one size pipe to another—extreme simplicity of operation and control—absolute accuracy—and real economy in operation and up-keep—these are cardinal points in the MERRELL.

WRITE NOW FOR NEW CATALOGUE.

THE MERRELL MFG. CO., 15 Curtis St., TOLEDO, O.

Cold Hard Facts about a Pipe Cutting Machine

Looking at the Forbes from a purely business standpoint—your business possibilities and profits are limited without one. Pretty strong statement but here's how we back it up—



It saves the wages of two to five men.

With a Forbes, one man can cut off and thread all sizes of pipe up to fifteen inches—a boy is capable for the smaller sizes.

It's the only Portable Pipe Machine on the market

Its strength and lightness make it portable for outside work—eliminating carting expense and delay. Its great compactness adapts it for use in confined places—threading pipes in the trench, etc.

Forbes Dies are adjustable and can be ground on an ordinary grindstone without first drawing the temper. Lost or broken dies we can replace without buying a new set. All parts are interchangeable. Simply name it and send shop number.

If you are interested in Profitable Equipment, you should know the How and Why details of the Forbes. A postal will bring them.

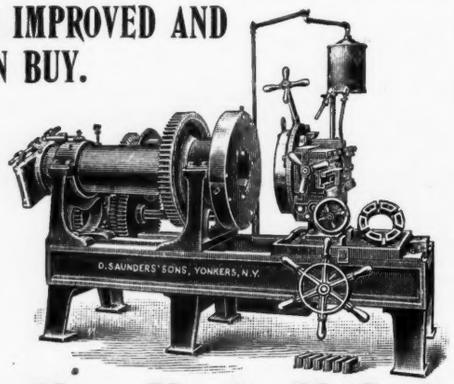
The Curtis & Curtis Co.
8 Garden Street, BRIDGEPORT, CONN.

THERE'S A DIFFERENCE BETWEEN SAUNDERS' No. 6 IMPROVED AND THE BEST MACHINE OF ANY OTHER MAKE YOU CAN BUY.

But the additional cost is so slight, when greatly increased output and quality of work is considered, that you'd never hesitate to choose a Saunders' for your work.

This machine provides ample power and speed for every size of work between 2½" and 8". Instantaneous control, adjustable expanding die heads, interchangeable chasers, etc., peculiar to this line are not attributes to machines other than as made by Saunders.

Write for catalog with full description.



D. SAUNDERS' SONS, Yonkers, New York, U. S. A.

THE TRIMO

The Interchangeable Jaw in the handle when replaced makes a new wrench out of an old one.

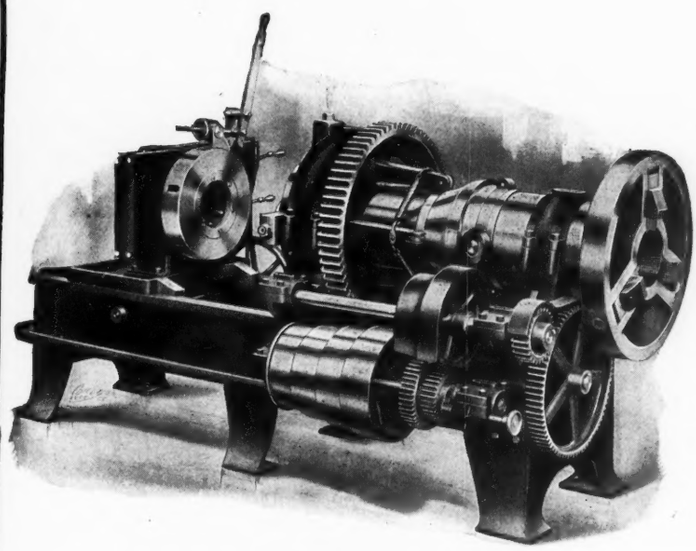
The Arm of Might
and
The Weapon of Strength
Make Labor Light

Send for Catalog No. 75

MADE BY

TRIMONT MFG. CO.
Roxbury, Mass.

Look at Bignall and Keeler Machines from Both Sides



P. D. Q. C. No. 6 Improved—Rear View

All operating conveniences are brought to the front of the machine and as near the hands of the operator as possible. But the rear of the machine is given equal attention to reduce complications, increase rigidity and add durability and speed to the powerful drive.

The famous "Peerless" Die Head and Quick Adjusting Mechanism, as well as many other exclusive B & K features, are advantages of these machines.

Write for information of any kind regarding Pipe Machinery. We are glad to answer inquiries promptly.

BIGNALL & KEELER MFG. COMPANY, Edwardsville, Ill., U. S. A.

FOREIGN AGENTS: Chas. Churchill & Co., London, Birmingham, Manchester, Glasgow. Schuchardt & Schutte, Berlin, St. Petersburg, Vienna, Stockholm. Alfred H. Schutte, Cologne, Paris, Milan.

Pipe Threaders and Cutters

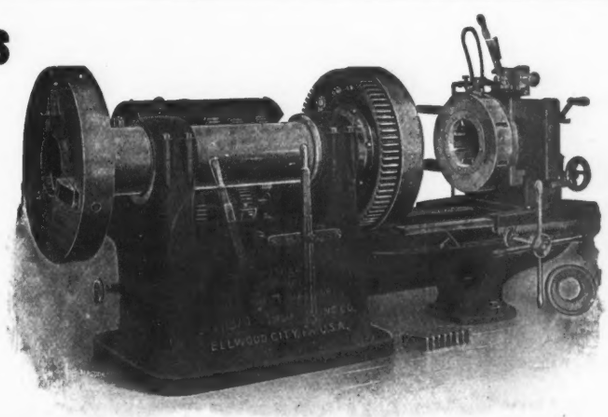
With efficiency as well as beauty.

Heavy—none more so; bed cast in one piece, no stands or legs to work loose. No oil soaked floors; fire risk reduced.

Single speed pulley; all gear speed changes through semi-steel cut gears.

Deep chasers cutting long taper perfect threads in one cut as easily on steel as on iron pipes.

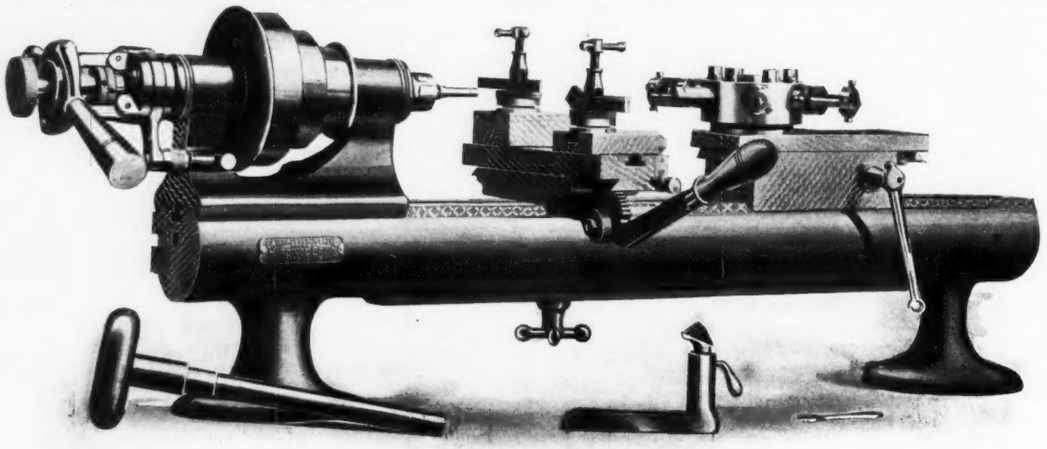
Let us prove to you that the higher cost of a modern tool is justified by the character and quantity of its product. *Circulars for the asking.*



Standard Engineering Co.
Ellwood City, Penna.

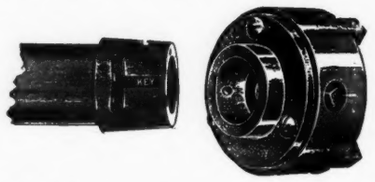
St. Louis Office: 1012 Chemical Building.

The "Little-Friction" Lathe for Precision Work



HARDINGE CATARACT No. 3 LATHE

Maintains spindle alignment regardless of end shake and runs free from heat at the highest speeds. Drills up to ½" may be used with the Hardinge—although it carries only a 1" belt. With end thrust and friction on the bearings practically eliminated, roughing and drilling that was formerly impossible on a small lathe is readily accomplished, and a big percentage of time and trouble saved. The patent taper nose spindle, another Hardinge advantage, permits interchangeable chuck fixtures to be run dead true and driven right or left as desired. Other features advantageous both to work and operator are described in the Catalogue 07.



Three Sizes. Full List of Attachments. Special Standard Bench Equipment.

HARDINGE BROTHERS, Inc., 3133-3141 Lincoln Ave., Chicago, Ill.

DRILL VISE WITH JIG ATTACHMENTS

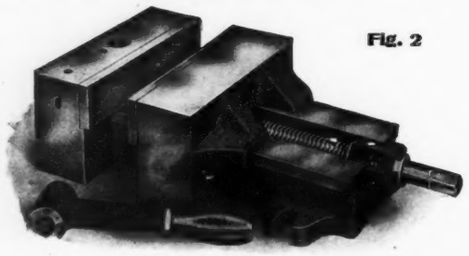


Fig. 2

As an ordinary Vise

Always a good Vise for **general shop use** and at the same time holds work for duplicate drilling **without the cost of a jig.**

They will pay. More time is consumed in catching work than in drilling it.

PATENTED

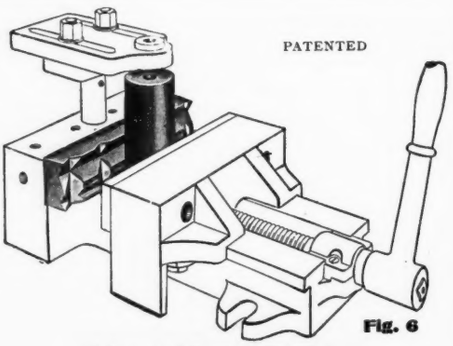


Fig. 6

V-Jaw and Part of Jig Fixture

Made with Jaws, 6", 9" or 12" long.

In circulars we show special features.

PATENTED

DRILL SPEEDER

For use in all presses from 20" up

NOTE

1—It increases the speed **three times.**

2—It has **safety frictions** to save the drills.

3—It has **sensitive feed** lever.

KNURL HOLDER

For Turret Machines

SOME THINGS ABOUT IT

1—It fits into any turret head.

2—It will knurl any size within its capacity, viz: 2½ diam. by 2½ long.

3—It is run onto the work like a screw plate.

Patented Aug. 10, 1909

THE GRAHAM MFG. COMPANY, PROVIDENCE, R. I.

Germany, Schuchardt & Schutte

THE ACME AUTOMATIC

For over ten years we have labored hand in hand with our production department—where hundreds of Acmes are operated daily—for the most practical development of the Acme Automatic Multiple Spindle Screw Machine, on all kinds of jobs in brass, steel and iron, from the solid bar.

These years of successful experimentation with the one machine, coupled with the evidence from our customers, have proved to us and to all Acme users that the Acme is the fastest automatic tool of its kind. Let us prove it to you.

The Single Drive, Easy Control, general convenience and low upkeep are reasons why; ask for them in detail.

50 to 400% more parts per machine per day.

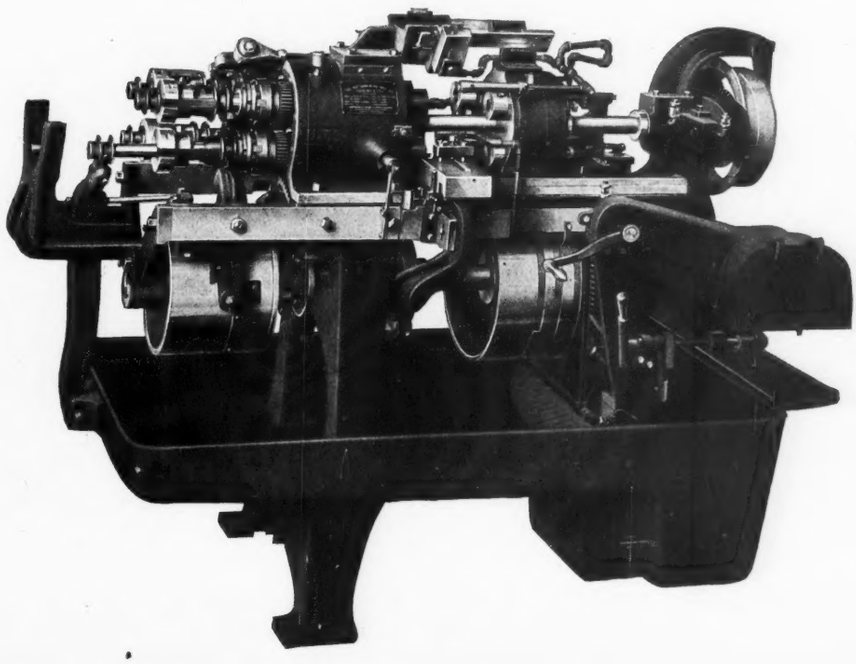
THE NATIONAL-ACME MANUFACTURING CO.

CLEVELAND, OHIO

NEW YORK, 77 WHITE ST. BOSTON, 141 MILK ST. CHICAGO, 549 WASHINGTON BLVD.
DETROIT, 1222 MAJESTIC BLDG. ATLANTA, CANDLER BLDG.

GENERAL FOREIGN REPRESENTATIVES

SCHUCHARDT & SCHUTTE — BERLIN — VIENNA — ST. PETERSBURG — COPENHAGEN — BUDAPEST — SHANGHAI
ALFRED H. SCHUTTE — COLOGNE — PARIS — BRUSSELS — LIEGE — MILAN — MADRID — BILBAO — BARCELONA



Divided Responsibility means Added Efficiency

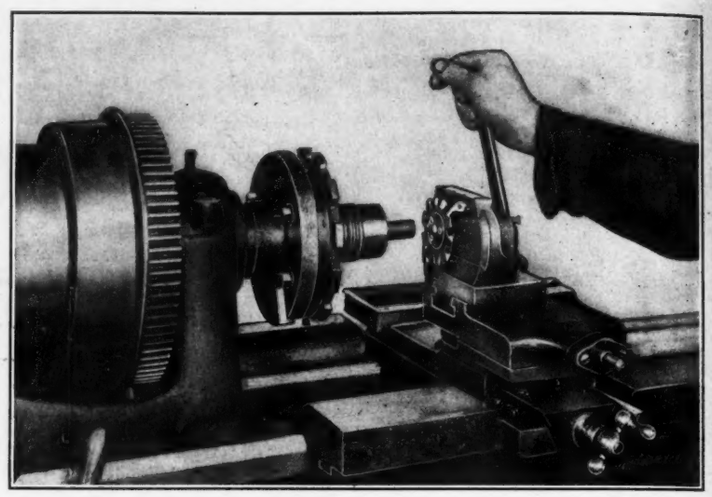
Each of the ten points on the

Rivett-Dock Threading Tool

cuts its share of the finished thread.

Designed for high speed on hard, tough work where the one-point tool falls down.

It not only saves all strain on the machine by having a support directly under the point, but chatter is entirely eliminated and inaccurate results from an overworked tool become practically impossible.



Showing the tool in position on lathe.

The Rivett-Dock tool has the capacity of a hundred single point tools, and is so nearly automatic in action that even the unskilled operator cannot make a mistake and spoil either work or tool.

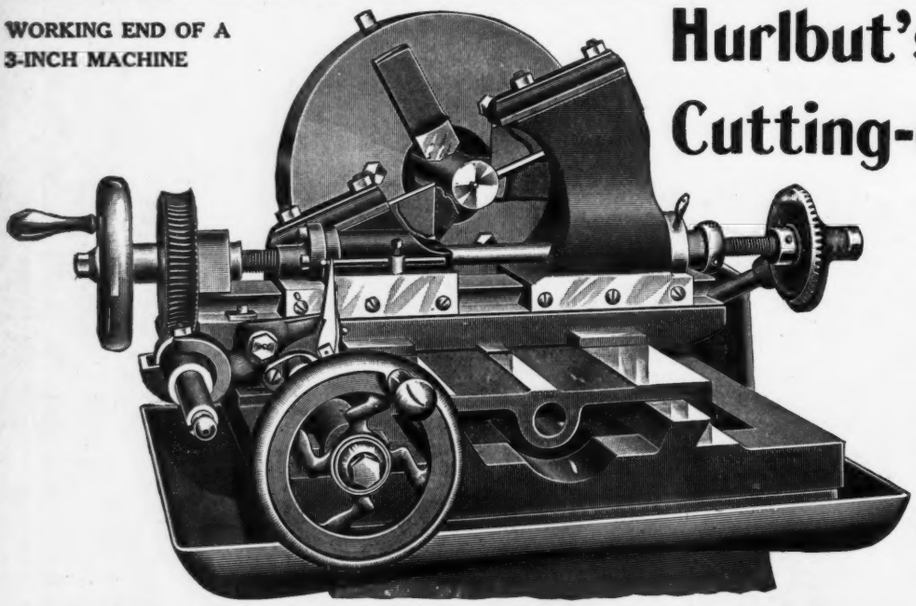
If **accurate** duplicate threading is a factor in your product, write for the Rivett Catalogs.

Also builders of the Rivett Precision Lathe and Rivett Internal Grinders.

Rivett Lathe Manufacturing Co.

BOSTON, (Brighton District) Mass., U. S. A.

WORKING END OF A 3-INCH MACHINE



Hurlbut's Patent Cutting-off Machine

Made in 2-inch, 3-inch, 4-inch, 5-inch, 6-inch, 8-inch and 10-inch sizes.

Circulars on application.

HURLBUT-ROGERS MACHINE CO.

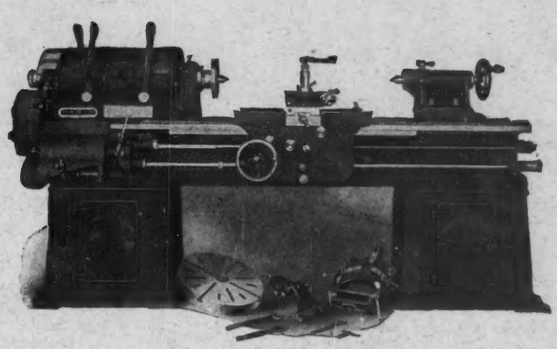
So. Sudbury, Mass.

IN CRUCIBLES---UNIFORMITY - ECONOMY

Only the very best, that is—the most uniform, the most dependable crucibles SHOULD be used. If you don't USE ours it's because you don't KNOW ours. Let us show you?

WRITE DEPT. F FOR LISTS AND PRICES.

McCULLOUGH-DALZELL CRUCIBLE COMPANY, - - - PITTSBURGH, PA.



A TINY CUT—BUT—A MIGHTY MACHINE

BUSINESS

is here. It is here to stay, so it's up to you to get out your product. Don't lag behind while competitors all around you are reaping handsome profits. Can you afford to allow this to go on?

Try a

Prentice High-Speed Lathe

and you will soon find that you are not only crowding your competitors, but have got them "beaten a mile".

QUALITY AND QUANTITY—THAT'S PRENTICE

Send for Circulars

PRENTICE BROS. COMPANY

WORCESTER, MASS., U. S. A.

"Builders of Radial and Upright Drilling Machines, Engine and Turret Lathes"

AGENTS—The Fairbanks Company, New York, Albany, Boston, Philadelphia, Pittsburg, Syracuse, Hartford, Baltimore, New Orleans and Buffalo. The Strong, Carlisle & Hammond Company, Cleveland and Detroit. The O. L. Packard Machinery Company, Chicago and Milwaukee. The Brownell Machinery Company, Providence. L. Booth & Sons, Los Angeles and San Francisco, Cal. Alfred H. Schutte, Cologne, Bilbao, Milan, Brussels and Liege. Schuchardt & Schutte, London, Berlin, Stockholm, St. Petersburg, Vienna, Copenhagen and Budapest.

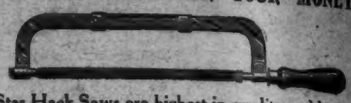
Small Surface Grinder

Furnished with plain table shown in cut, or with adjustable table illustrated on Page 83 of Catalog.

A 12" x 2" wheel on one end of Spindle is used for *Ordinary Grinding.* The other end of Spindle is fitted with a removable taper shank arbor which takes a 10" x 1" wheel for *Surface Grinding.*

Diamond Machine Co.
PROVIDENCE, R. I.

GET THE MOST FOR YOUR MONEY

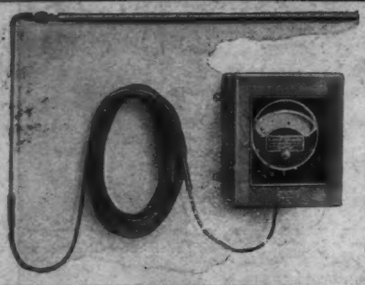


Star Hack Saws are highest in quality and lowest in price. These two features work well together. Look at this price list:

Length of Blade	6	7	8	9	10	11	12	inch
Price Per Dozen	30	32	34	38	42	46	50	cents

N.B.—Blades which we are now turning out are the best we have ever made. Ask for Catalog.

MILLERS FALLS COMPANY
28 Warren Street, New York, N. Y.



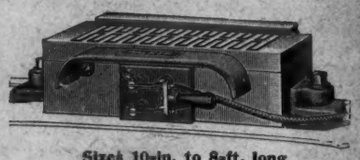
W. H. Bristol Electric Pyrometers

Especially valuable for Hardening Furnaces

Write for full information and a copy of the new *Illustrated Index* of Bristol Recording Instruments, including more than 50 illustrations of Bristol Instruments.

THE BRISTOL COMPANY, Waterbury, Conn.

More than 2000 in use



Sizes 10-in. to 8-ft. long

MAGNETIC CHUCKS

FOR

Flat Surface Grinders
Rotary Surface Grinders
Universal Grinders
Piston Ring Grinders
Disc Grinders
Cup Wheel Grinders
Knife Grinders
Vertical Milling Machines
Planers

SPECIAL CHUCKS TO ORDER

Patentees and Sole Manufacturers

O. S. WALKER & CO.
Worcester, Mass.

EST. 1863. **BLACK DIAMOND FILE WORKS** INC. 1893.

TWELVE MEDALS awarded at INTERNATIONAL EXPOSITIONS.

GRAND PRIZE GOLD MEDAL at Atlanta, Ga., 1895.

Catalogue sent free to any interested file user upon application.

G. & H. BARNETT COMPANY, - Philadelphia, Pa.

CLEASON WORKS

ROCHESTER, N.Y.

DELTA

FILES OF QUALITY

DELTA FILE WORKS CARVER FILE CO. PHILADELPHIA PA.

AN INDEPENDENT ORGANIZATION Not connected with the trust in any way

DID YOU ⓒ PAGE 31-I.E. WHAT ⓒ STANDS FOR?

Taps and Dies For all uses where **Quality Counts**

Send for Catalog

A. J. Smart Manufacturing Co., Greenfield, Mass., U. S. A.

DROP PRESSES For all Purposes Our Specialty.

MINER & PECK MFG. CO.
PROPRIETORS OF
The Peck Drop Press Works, New Haven, Conn.

No Loose Collets—
Straight Threads Assured.
J. M. CARPENTER TAP & DIE COMPANY
PAWTUCKET, R. I., U. S. A.
See our Ad. on Page 165.

CARPENTER'S PATENT ADJUSTABLE STOCKS

REGISTERED TRADE-MARK
C